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PHASE II SITE INVESTIGATION
AT PINE SWAMP
HAMDEN, CONNECTICUT
OLIN CORPORATION

June, 1982

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ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.
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PHASE II SITE INVESTIGATION
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OLIN CORPORATION

June, 1982

P-B300

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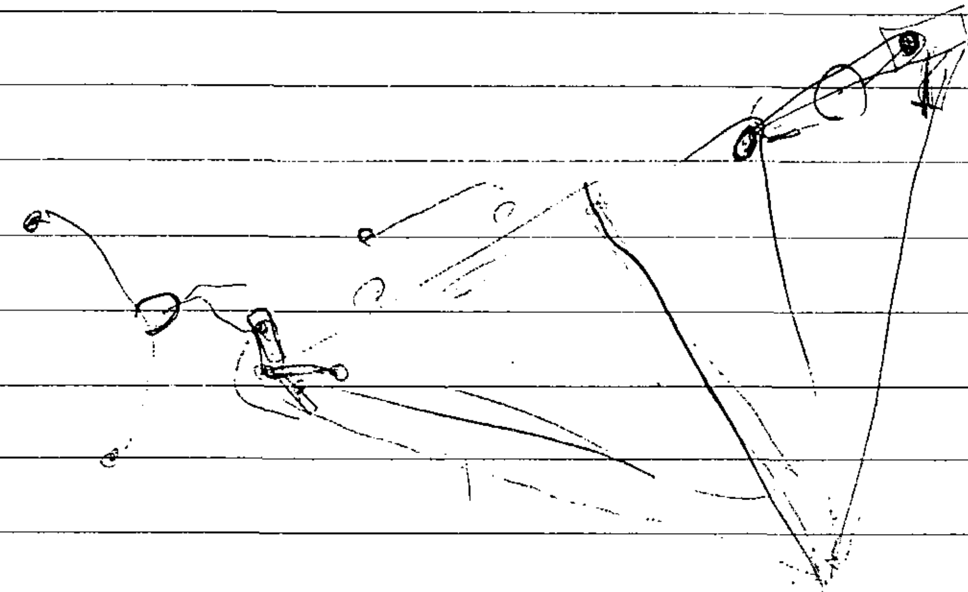

check 6.2 re item 2 exposed [illegible] for
in several areas

23 borings

all but the analyses in bottle area no anything found

8 borings analyzed for metals - number of [illegible] analysis

15 borings not analyzed

kriging
[illegible]
weighting
technique

Nickel is not clustered tightly — how many
Dropping no adjacent samples - more [illegible] samples

O option leave out certain [illegible]
check 12"
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EXECUTIVE SUMMARY

This report summarizes the Phase II investigation of the impact that waste disposal at the Pine Swamp site in Hamden, Connecticut has on the quality of surface water and ground water that is tributary to the Lake Whitney reservoir. An evaluation of the impact and recommendations for improving general site conditions have been included. The Phase II investigation is in part based on the findings described in the Phase I report, "Environmental Investigation of Pine Swamp Hamden, Connecticut," dated January, 1981.

As a follow-on to previous work, Olin Corporation contracted with Environmental Research & Technology, Inc. (ERT) to conduct a field investigation and analytical program to address specific concerns regarding the effects of waste disposal at the site. These concerns were directed at the degree of mobility of metal and organic constituents within waste located in discrete areas of the site, and the impact these constituents have on present and proposed drinking-water supplies downgradient from the site. In December 1981 ERT undertook a field and analytical program to investigate these concerns.

Conclusions

Based on the findings of the Phase II investigation, ERT concludes that past waste disposal activities at the Pine Swamp site have not and are not anticipated to adversely affect Lake Whitney or downgradient drinking-water supplies.

Specific conclusions are as follows:

- Waste contained in disposal areas other than the battery waste area have no measurable effect on surface water or ground water quality on the site.
- Metals are slowly leaching from the battery disposal area, however, they do not affect Lake Whitney water quality or downgradient drinking-water supplies.

- Leachate is moving from the battery disposal area into the shallow ground water and into Pond A, however the rate is slow.
- Metal consistuents in the battery waste that have leached into the shallow ground water have not redepositied in the underlying natural sediments.
- The quantity of metals from the battery waste is insignificant compared to off-site sources of metals to the pond system.
- Metals from the battery waste area will not affect Lake Whitney or future drinking water-supplies developed downgradient if the waste is left undisturbed.
- Although a random distribution of several priority pollutant organic chemicals was detected at low concentrations (less than 86 ppb) in the ground water at the Pine Swamp site, none was detected in the sample from the regional aquifer at the outlet of the site (ERT 7). Thus, with respect to organic priority pollutants, past waste disposal activites at the site have not and are not anticipated to in the future adversely affect Lake Whitney or drinking-water supplies downgradient.
- Odors noted in several of the wells on-site and off-site result from one or more of at least four non-priority pollutant organic chemicals in the ground water. They are: tertiary butyl alcohol, acetone, tetrahydrofuran and ethyl ether. Their concentrations range up to approximately 5,300 ppb.

Recommendations

ERT recommends that Olin Corporation pursue several activities to further reduce the potential for future impact of the site and suspected off-site sources on downgradient drinking-water supplies. The areas identified for action are:

- The broken storm sewer near ERT 9 should be repaired so that water from the sewer is conducted directly to Pond A rather than allowed to wash across the surface of the site in an area where battery waste has been identified at and near the surface.

- Battery waste is exposed at the surface in several areas, and it is known to contain elevated concentrations of cadmium and lead. ERT recommends that the exposed battery waste be covered with select fill, graded to control runoff and seeded to stabilize the surface.
- Institution of a limited ground-water and surface-water monitoring program would provide a means to confirm the above conclusions and to assess the future impact of the site and suspected off-site sources on downgradient drinking-water supplies.

Investigative Procedures

The field and analytical program included the following procedures.

- A reconnaissance of the entire site was conducted to locate all waste disposal areas evident at the surface.
- Twenty-three borings were drilled with samples of soil and waste extracted from each.
- Seventeen observation wells were installed.
- Seventeen wells including two off-site wells were sampled and analyzed for volatile priority pollutants.
- Thirteen wells including two off-site wells were sampled and analyzed for base/neutral priority pollutants.
- Three wells were analyzed for acid-extractable and pesticide priority pollutants.
- Twenty-three wells including two off-site wells were sampled and analyzed for cadmium, chromium, mercury, manganese, lead and zinc.
- Five surface-water samples were taken and analyzed for the metals listed above. One surface-water sample was also analyzed for volatile and base/neutral priority pollutants.

- Eighteen soil and waste samples from the battery disposal area were subjected to the EP toxicity test and analyzed for cadmium, total chromium, hexavalent chromium, mercury, manganese, lead and zinc.
- One bottom sediment sample from Pond A was analyzed for total content of cadmium, chromium, mercury, manganese, lead and zinc.

Findings

This extensive field and analytical program produced the following findings.

- Approximately 3500 cubic yards of waste containing the remains of flashlight batteries underlie the site in an area of about 32,000 square feet adjacent to the southwest shore of Pond A.
- Three other small disposal areas not previously addressed in the Phase I study were investigated. They are located to the southwest of Pond A, to the southwest of Pond C, and in the southeast kettle. These areas contain primarily incinerater ash, demolition debris, domestic-type refuse and Ramset test pads.
- There is a perched ground-water mound underlying the battery waste disposal area. It is perched on top of fine-grained sediments composed of fine sand, silt and clay that underlie the waste. These sediments restrict shallow ground-water flow to primarily lateral paths toward Pond A.
- The battery waste samples contained concentrations of cadmium, manganese, lead and zinc that are higher than on-site background concentrations.
- Four of the waste samples from the battery disposal area satisfied EPA's criteria for characterization as a hazardous waste for cadmium and/or lead content. These metals, however, are not found at elevated concentrations in the soil underneath the waste.

- The concentrations of cadmium, manganese, lead and zinc in the perched ground water in the battery waste area are higher than background concentrations in the regional aquifer.
- Ground water discharging from the site contains concentrations of zinc and mercury which are of the same order of magnitude as concentrations of these metals in ground water moving onto the site.
- Surface water discharging from the site contains metal concentrations that are not adversely affecting the quality of downgradient drinking-water supplies, and these metal concentrations are lower than metal concentrations in Pond A.
- The total metals content of the Pond A bottom sediments is less than or within concentration ranges of the metals measured by others in Lake Whitney and Lake Saltonstall reservoir bottom sediments.
- Comparison of the estimated input of zinc (chosen as the indicator metal) to the Pine Swamp pond system indicates that the rate of zinc input to the pond system via street drains from the neighboring urban area is approximately 400 times greater than the estimated input rate of zinc from the battery disposal area.
- One priority and one non-priority pollutant organic compound was detected in wells upgradient from the battery disposal area. The concentration of the priority pollutant was 20 ppb and the concentration of the non-priority pollutant was 200 ppb.
- Low levels (less than 360 ppb) of two priority and two non-priority pollutant organic compounds were detected in samples from two out of five wells screened in the perched ground water in the battery disposal area.
- Three priority pollutant organic compounds were detected at low levels (less than 86 ppb) in the regional aquifer underlying the southeast kettle. None was detected in the aquifer 200 ft downgradient from the kettle. Therefore, the locally detected low level concentrations of organic

chemicals are not having an adverse impact on downgradient drinking-water supplies.

- No volatile or base/neutral priority pollutants were detected in the ground water discharging from the site (ERT 7).
- Surface water discharging from the site was found to contain 11 ppb 1,1,1-trichloroethane. This concentration is only 1 ppb greater than the detection limit.

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1. INTRODUCTION

Pine Swamp is an undeveloped site of approximately 102 acres in Hamden, Connecticut owned by the Olin Corporation. Over half of the site consists of five interconnected ponds which drain into Lake Whitney, a drinking-water supply for several communities in the New Haven water district. The area around Pine Swamp is highly developed with industrial, commercial and residential establishments (Figure 1-1).

The site was used as a storage area for gunpowder required in the production of ammunition at the Winchester plant in New Haven for about 60 years. A small area in the southwest corner of the property was once used for the burning of materials generated at the Winchester plant, as well as for disposal of off-specification batteries and building demolition material from the plant. The site has not been used for burning or disposal since 1966.

In early 1980, Olin contracted with Environmental Research & Technology, Inc. (ERT) to conduct a preliminary investigation of the Pine Swamp site. The objectives of this Phase I study were to assess the effect of past activities on the site and to evaluate the present environmental condition of the site. Phase I concluded in January 1981 with the submittal of the document entitled "Environmental Investigation of Pine Swamp, Hamden, Connecticut." At Olin's request, ERT initiated a Phase II investigation in November 1981 to determine the impact of off-specification battery waste upon shallow ground water at the site and to investigate the nature and extent of other disposal areas which are located on the site.

1.1 Objectives of Phase II

The first objective of the Phase II investigation was to determine the impact of waste materials adjacent to Pond A upon shallow ground water at Pine Swamp. Fourteen shallow monitoring wells were installed and six test borings were drilled in the battery waste disposal area to collect soil and ground-water samples. Water samples were also collected from the ponds and inlet stream. Two bottom-sediment samples were collected from Pond A at the point nearest the

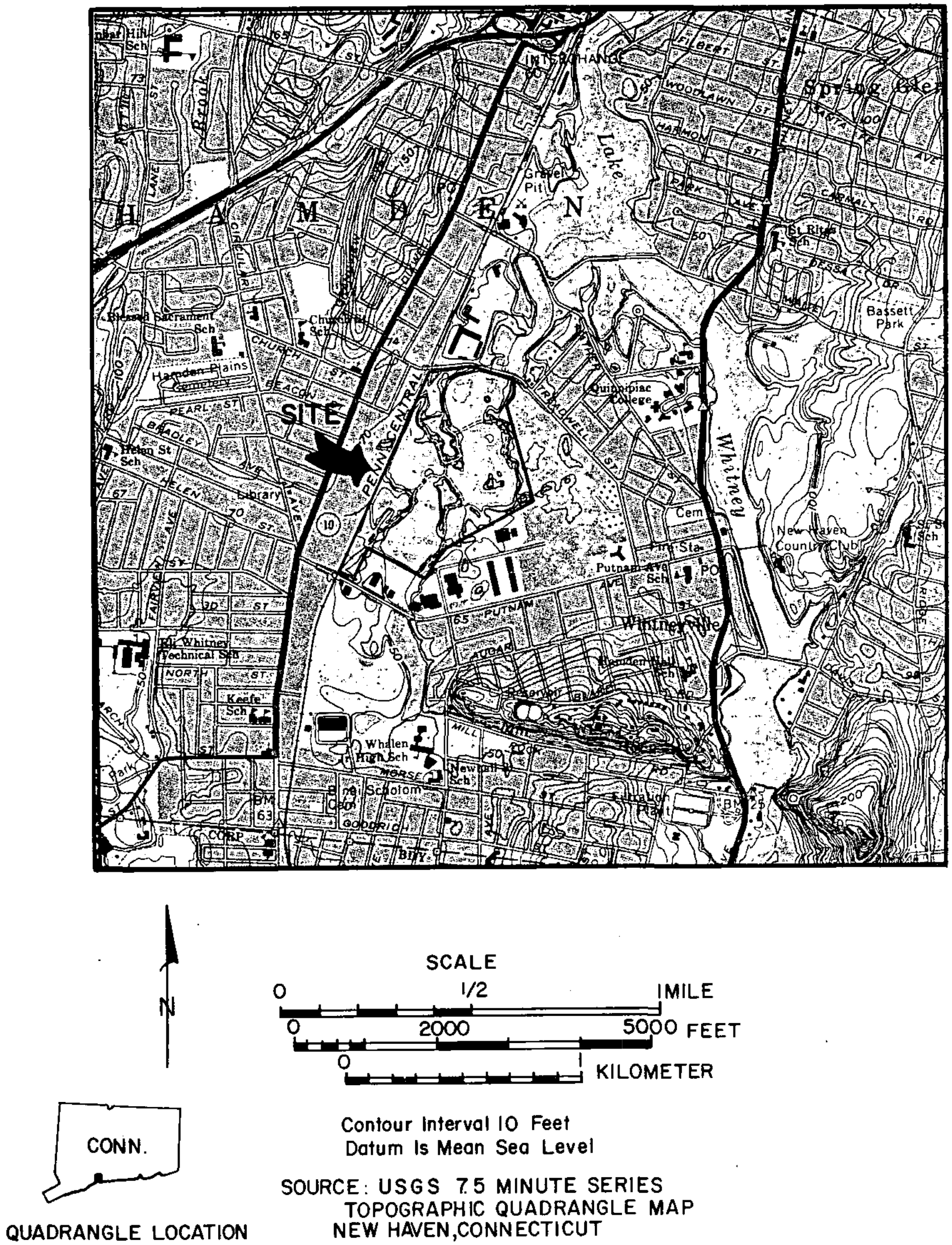

FIGURE-1-1 SITE AREA TOPOGRAPHIC MAP

HT143

battery-waste disposal area. Soil samples were analyzed for ambient pH and for leachable metals (cadmium, chromium, hexavalent chromium, lead, manganese, mercury and zinc) using the EPA extraction-procedure (EP) toxicity test. Water samples were analyzed for one or more of the following constituents:

- metals (cadmium, chromium, lead, mercury, manganese, and zinc)
- base-neutral extractable organics on the EPA priority pollutant list
- volatile organics on the EPA priority pollutant list
- other organics, as required.

The second objective of the Phase II investigation was to investigate the nature and extent of other disposal areas located at the Pine Swamp site. To accomplish this objective, a site reconnaissance was performed. Three areas previously used for dumping were investigated and mapped. Three monitoring wells were installed near a kettle in the southeast area of the site where approximately 25 rusted metal containers and demolition debris are located. Soil and water samples collected in this area were analyzed for metals, pesticides, and base-neutral, acid extractable, and volatile organics. Field and analytical data were interpreted and evaluated with regard to the objectives of the study.

1.2 Organization of the Report

The conclusions of the Phase I investigation are reviewed in Section 2. ERT's activities in the field during the Phase II study are described in Section 3. Section 4, Data Analysis and Interpretation, discusses the results of the site reconnaissance, summarizes surficial geology and hydrogeology of the site, and evaluates soil and water analytical data. Section 5, Discussion, presents a condensed overview of the findings that lead to the major conclusions of the investigation. Conclusions and recommendations are addressed in Section 6.

2. REVIEW OF PHASE I INVESTIGATION

2.1 ERT's Conclusions

ERT's Phase I investigation conducted between June 1980 and January 1981 centered around the area southwest of Pond A (Figure 2-1). Excavation of test pits confirmed that two small areas had been used predominately for burning scrap wood (west and east burning areas). These areas also contained minor amounts of battery waste, scrap metal, and glass bottles. A central disposal area appeared to have only been used for burial of building demoliton rubble. A fourth site, close to Pond A, contained battery waste, demolition rubble, domestic waste, and miscellaneous debris from the New Haven Winchester plant.

Water quality analyses of samples taken in and near these disposal areas showed only minor concentrations (less than 29 ppb) of organic compounds in deep ground water. Higher concentrations of organic compounds were detected in a sample from ERT-5 (east of the disposal areas), but these were thought to result from an off-site source near the southeast corner of the Pine Swamp site. Samples of deep ground water in the immediate vicinity of the west burning area were slightly enriched with several inorganic compounds, but the enrichment appeared to be only local. Manganese concentrations were approximately ten times background levels of 0.05 ppm. Natural attenuation of inorganics appeared effective in preventing any impact of concern upon ground water.

Analyses of samples collected from Pond A showed no measurable impact on ground water flowing through the disposal areas and discharging to the pond, or upon pond-water quality. Surface-water quality appeared to be more directly related to natural pond vegetation and surface runoff.

The bottom sediment of the pond is natural organic silt and peat. It appeared to be a sink for inorganic compounds. Organic and metal compounds in the sediment showed no measurable exchange with pond water, and therefore do not adversely affect pond-water quality.

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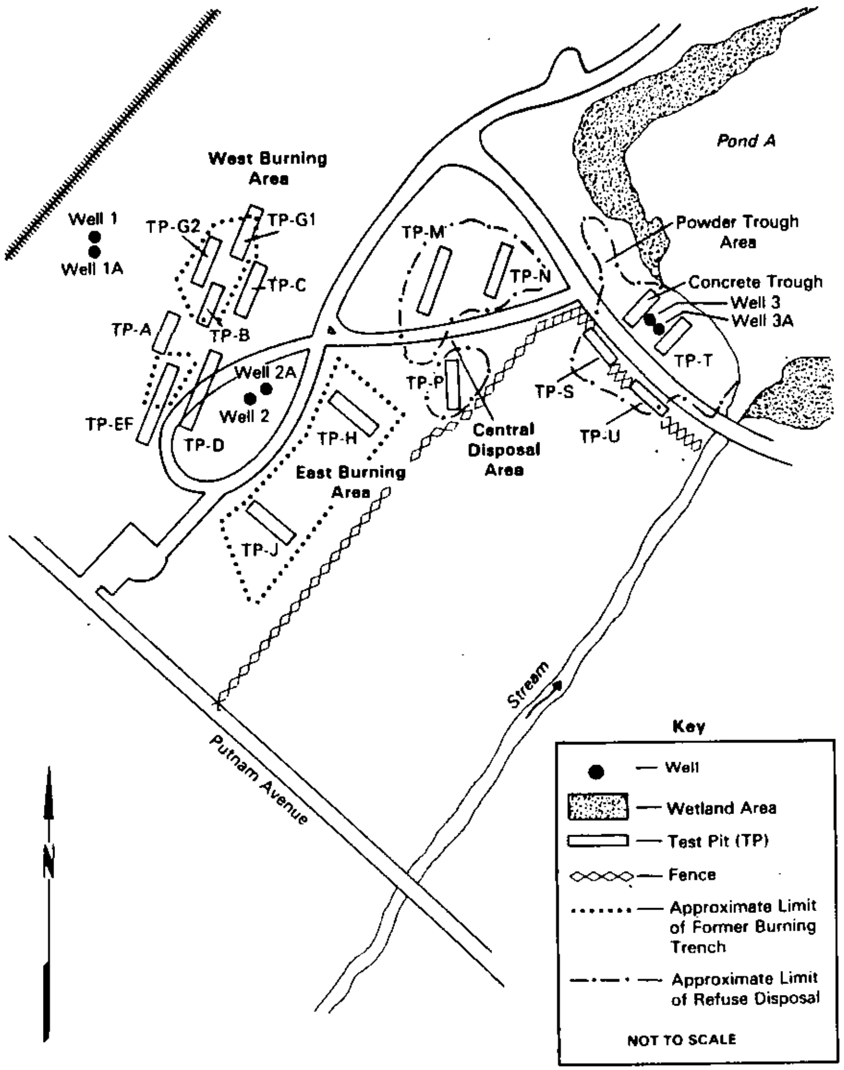

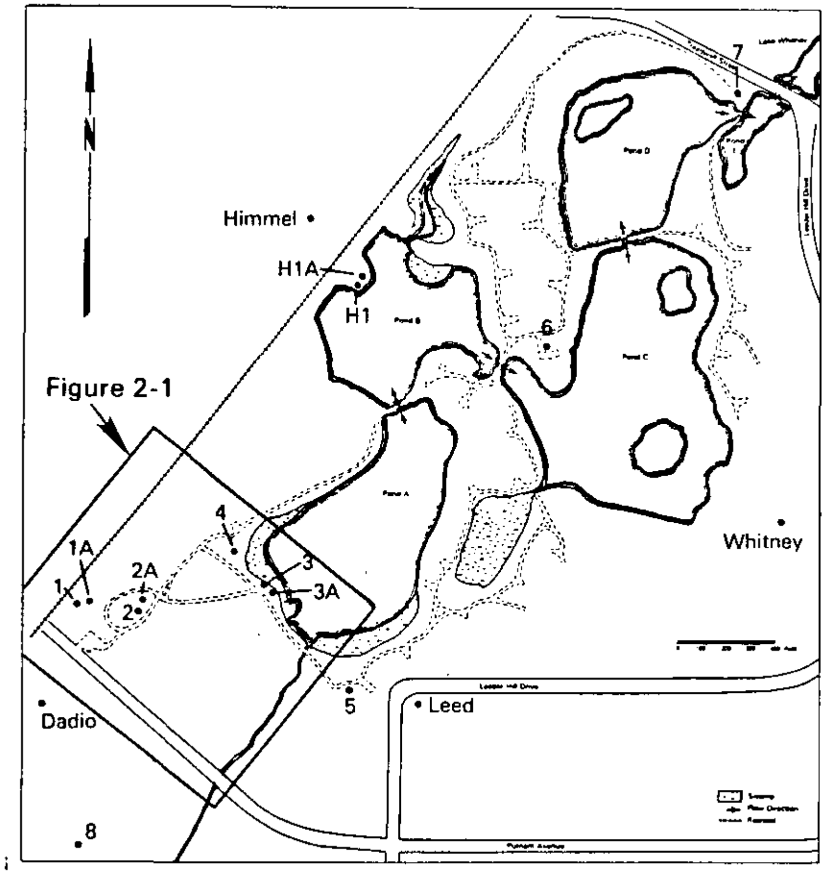

Index Map for Figure 2-1

Figure 2-1 Phase I Investigation Area

3. DESCRIPTION OF THE FIELD PROGRAM

Based on the Phase I investigation, ERT, on behalf of Olin, undertook a field exploration program conducted from December 1981 to February 1982 that was designed to determine the nature and extent of waste disposal at the Pine Swamp site and the impact of this disposal on Lake Whitney and downgradient drinking-water supplies. The program included: drilling 23 borings and extracting soil and waste samples; installing 17 observation wells and sampling ground water from these wells; sampling surface water; and mapping the waste disposal areas. Table 3-1 lists the rationale for each boring and well location. Figure 3-1 (in pocket) shows the location of the borings, wells, sampling locations, mapped waste-areas, and test pits fom Phases I and II that constitute the field program.

3.1 Soil Sampling

Soil samples were extracted from borings augered by a Mobile B30 drill rig mounted on a Bombadier tracked vehicle. Samples were taken by pressing a 2 1/2 inch ID split-spoon sampler into the soil. Where penetration of the soil was difficult, the split spoon was hammered in by repeatedly dropping a standard 140 lb hammer onto a drive head attached by drill rods to the split spoon. The boring itself was advanced with hollow-stem augers through which the split-spoon sampler was used. In several borings, where detailed sampling was not required, samples were taken off the auger flights after the auger had been pulled straight-up out of the boring.

All samples were placed in labeled glass jars in the field. An ERT geologist supervised the boring operation and recorded visual descriptions of the samples. Sample descriptions and detailed information of the borings appear on the boring logs in Appendix A.

3.2 Observation - Well Installation

Upon completion of a boring in which a well was to be installed, a slotted, Schedule 80, threaded coupling, PVC well screen, and, where appropriate, PVC riser were placed inside the hollow-stem augers. The

TABLE 3-1

RATIONALE FOR BORING AND OBSERVATION-WELL LOCATION

Boring/ Well No.	Rationale
ERT 9	Battery remains at surface. Shallow ground-water sampling.
ERT 10	Shoreward extent of waste.
ERT 11	Southeastward extent of waste.
ERT 12	Shallow ground-water sampling.
ERT 13	Southeastward extent of waste. Shallow ground-water sampling.
ERT 14	Southeastward extent of waste. Shallow ground-water sampling.
ERT 15	Northwestward extent of waste. Shallow ground-water sampling.
ERT 16	Northwestward extent of waste. Shallow ground-water sampling.
ERT 17	Southwestward extent of waste. Shallow ground-water sampling.
ERT 18	Shoreward extent of waste. Ground-water sampling in top of sand and gravel unit.
ERT 19	Shallow ground-water sampling.
ERT 20	Shoreward extent of waste. Ground-water sampling in top of sand and gravel unit.
ERT 21	Shallow ground-water sampling.
ERT 22	Shallow ground-water sampling, downgradient from dumping area.
ERT 23	Extent of waste. Shallow ground-water sampling.
ERT 24	To replace ERT 21 that was contaminated during installation.
ERT 25	Southeastward extent of waste.
ERT 26	Southwestward extent of waste.

TABLE 3-1 (Continued)

Boring/ Well No.	Rationale
ERT 27	Investigate nature of causeway fill.
ERT 28	Investigate nature of causeway fill.
ERT 29	Ground-water sampling at southeast kettle dumping area.
ERT 30	Ground-water sampling at discharge area into Pond C.
ERT 31	Ground-water sampling at discharge area into Pond C.

augers were then backed out of the boring. Sand packing was placed around the well screen in borings that did not immediately collapse around the well screen upon withdrawing the augers. In all cases, a bentonite (clay powder or pellets that expand upon contact with water) seal was placed around the top of the riser to prevent surface-water flow into the well. Details of the well installation are given in Appendix A on the boring logs.

3.3 Ground-Water Sampling

Ground-water samples were collected from the Pine Swamp site primarily between December 9 and 22, 1981. A total of 25 wells were sampled, including the well owned by Davenport Custom Lab on Putnam Avenue and the Whitney Center south well on Leeder Hill Drive. USGS (Brown 1970) and EPA (Scalf 1981) sampling procedures were employed to their practical extent in obtaining ground-water samples. All ERT wells were pumped with a gasoline-powered centrifugal pump until pH, specific conductivity, and temperature had stabilized. This is done to purge the well of stagnant water, and to ensure that fresh formation water is being drawn into the well. The high capacity Davenport and Whitney Center wells were pumped at least 15 minutes before samples were taken.

Once removal of stagnant water was completed, all sample bottles were filled using a peristaltic pump. Table 3-2 presents a list of the chemical analyses performed on the samples. All samples extracted for metals analyses were filtered prior to sample collection, except at the Whitney Center south well. EPA protocol was followed for sample preservation and storage (Federal Register 75050-75052, December 18, 1979).

3.4 Surface-Water Sampling

Surface-water samples were collected according to USGS procedures (Brown 1970) on February 22 and 27, 1982 using a peristaltic pump. Sampling locations are shown on Figure 3-1 (in pocket). Table 3-2 shows the chemical analyses performed on the surface-water samples.

TABLE 3-2

ANALYSES PERFORMED ON GROUND-WATER AND SURFACE-WATER SAMPLES

Sample Location	Analyses: Volatiles	Base/Neutrals	Acid Extractable	Pesticides	Metals
ERT 1					
ERT 1A					
ERT 2	X				
ERT 2A	X				
ERT 3	X				X
ERT 3A	X				X
ERT 4					X
ERT 5					X
ERT 7	X	X			X
ERT 9					X
ERT 12					X
ERT 13					X
ERT 14					X
ERT 15	X	X			X
ERT 16	X	X			X
ERT 17	X	X			X
ERT 18	X	X			X
ERT 19					X
ERT 20	X	X			X
ERT 22					X
ERT 23	X	X			X
ERT 24	X	X			X
ERT 29	X	X	X	X	X
ERT 30	X	X	X	X	X
ERT 31	X	X	X	X	X
Davenport	X	X			X
Whitney	X	X			
SW 1					X
SW 2					X
SW 3					X
SW 4					X
SW 5	X	X			X

Note: 1. SW1 through SW5 are surface-water samples; all others are ground-water samples.

2. Wells ERT 2, 2A, 3, 3A, 4, 5 and 7 were installed by ERT in 1980. Wells ERT 9, 12 through 20, 22, 23, 24, 29, 30, and 31 were installed by ERT in 1981.

Samples collected for metals analyses were also filtered in the field. EPA protocol for sample preservation and storage were followed (<u>Federal Register</u> 75050-75052, December 18, 1979).

3.5 Site Reconnaissance

ERT performed a reconnaissance of the entire Pine Swamp site to locate and map waste disposal areas visible at the surface that were not formally investigated in Phase I. Where waste was encountered, the area was mapped and hand-shoveled pits were dug to determine the nature and extent of the waste. In addition to locating these other areas of waste disposal ERT field verified the location, status and size of major surface-water input conduits. These conduits are generally street-drain discharges, and are mapped on Figure 3-1 (in pocket).

4. DATA ANALYSIS AND INTERPRETATION

This section contains a description of the major waste-disposal areas located during the site reconnaissance, a synthesis of the site geology and hydrogeology derived from the field exploration program, and a discussion of the results of the analyses conducted on soil, ground-water and surface-water samples. The discussion in this section summarizes the analytical data and compares that data to (1) on-site background concentrations and (2) where appropriate for soil samples, concentrations which meet EPA's hazardous waste characteristic of EP toxicity. Table 4-1 lists the analytical protocol for each analysis.

4.1 Waste Disposal Areas

Reconnaissance of the site revealed three major areas of waste disposal outside of the battery-disposal and burning-ground areas. These areas are located on Figure 3-1 (in pocket) and were mapped in detail (Figures 4-1, 4-2, and 4-3). Other small areas of waste disposal that were noted during the reconnaissance are depicted on Figure 3-1.

4.1.1 Southwest of Pond A

The disposal area southwest of Pond A is located to the northwest of boring ERT 22 and to the northeast of borings ERT 4 and ERT 16. It occupies an area of approximately 23,000 sq ft (Figure 4-1). The waste disposed of here includes: a large amount of unburned demolition lumber; end-dumped piles of incinerator ash; domestic-type rubbish; one pile of green sand; miscellaneous metal pieces; wooden crates; empty 5-gallon pails; spent shot gun shells; and concrete blocks. The waste along the northwest side of this disposal area appears to have been graded and now appears as an approximately 5 ft high lift of waste. In the remainder of this area the waste lies as deposited.

TABLE 4-1

ANALYTICAL METHODS

Procedure	Reference
EP Toxicity Extraction - Metals	Appendix 11 EP Toxicity Test Procedures 45 Fed. Reg. 33137, May 19, 1980.
Soils Extraction - Metals	USGS Extraction Procedure I-5485-78
Water Extraction - Metals	EPA, Metals, 4.1.3*
Total Metals once extracted from soil or water:	
Cadmium (Cd)	EPA 213.1
Chromium (Cr)	EPA 218.1
Haxavalent Chromium (Cr+6)	EPA 218.4
Lead (Pb)	EPA 239.1
Manganese (Mn)	EPA 243.1
Mercury (Hg)	EPA 245.1
Zinc (Zn)	EPA 289.1
Organics	
Volatiles	EPA 624
Base/Neutrals	EPA 625
Acid Extractables	EPA 625
Pesticides	EPA 625

*Unless otherwise indicated, EPA methods refer to EPA 1978 Methods for Chemical Analysis of Water and Wastes. EPA/600/4-79/929, 490 pp.

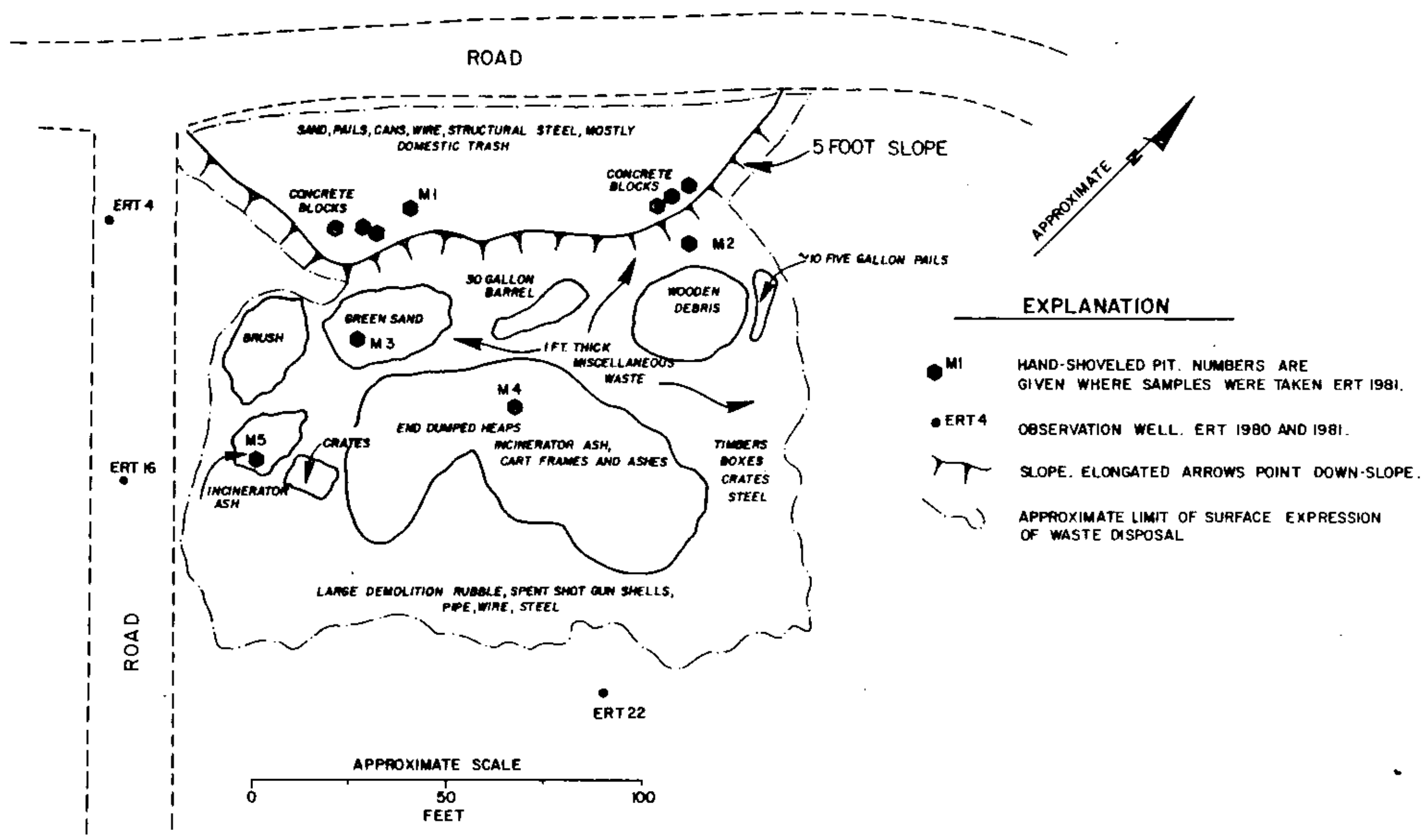

Figure 4-1 Map of Disposal Area Southwest of Pond A

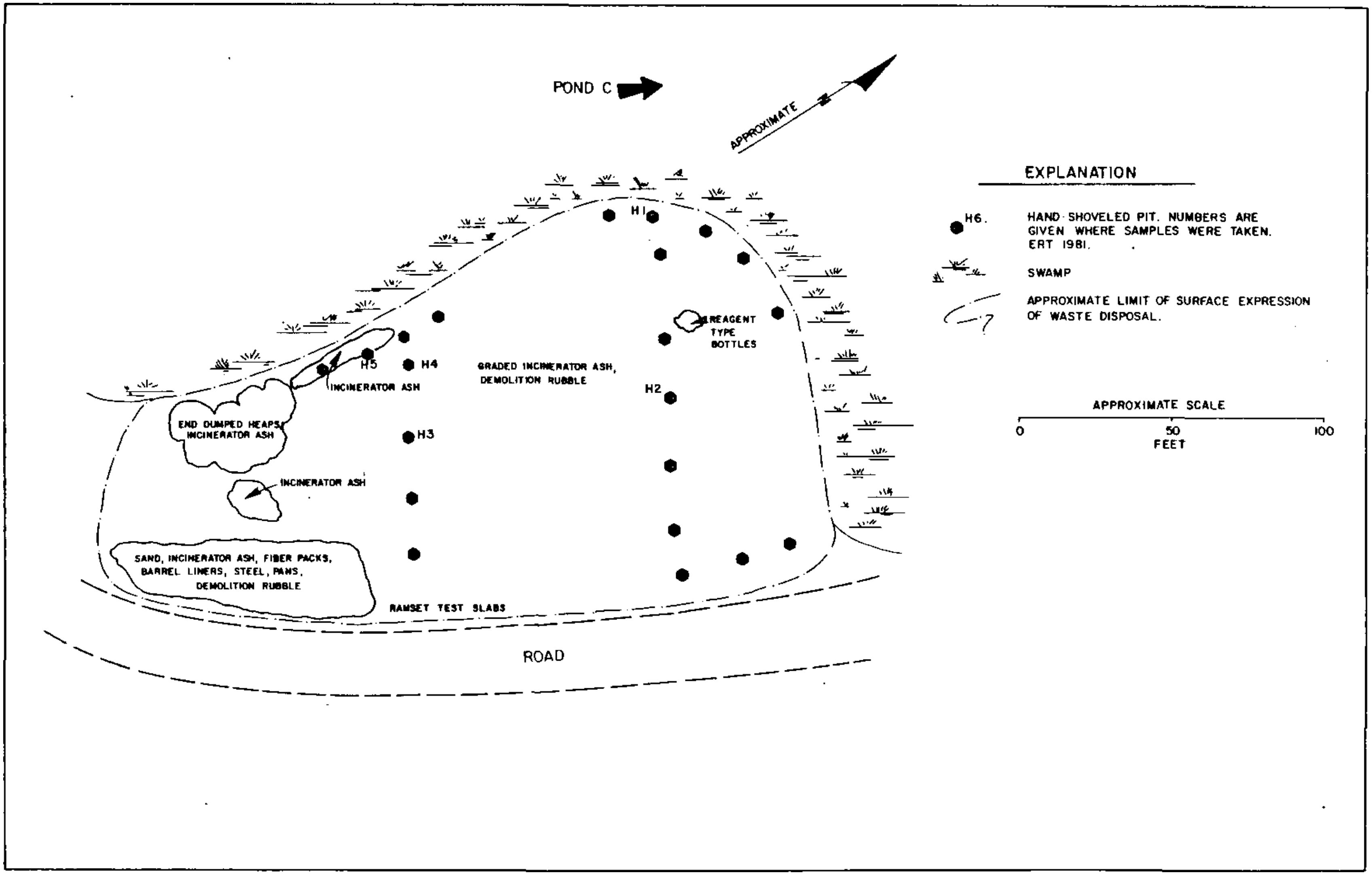

Figure 4-2 Map of Disposal Area Southwest of Pond C

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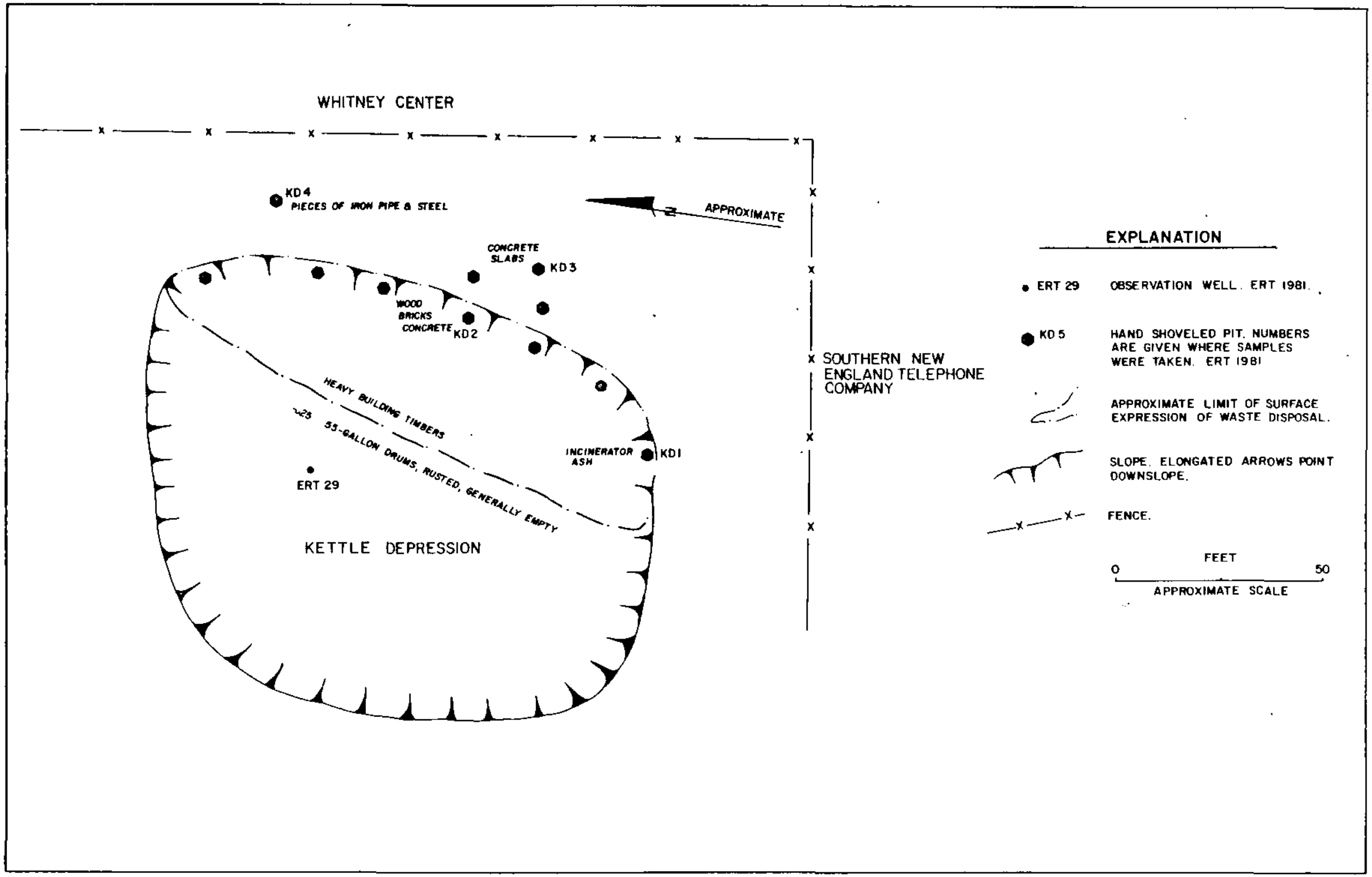


Figure 4-3 Map of Disposal Area at Southeast Kettle

4.1.2 Southwest of Pond C

This disposal area is located in the swamp between Pond A and Pond C, and occupies an area of approximately 20,000 sq ft (Figure 3-1 and 4-2). It is predominantly filled with incinerator ash that has been graded from the road out into the swamp. End dumped piles of incinerator ash occupy the southern third of the area. These piles overlie graded waste. Other identifiable waste included: empty reagent-type bottles; sand; fiber-pack liners; pans; miscellaneous metal parts; demolition rubble; and Ramset test pads. Approximately 200 ft in a northerly direction up the road toward Pond C is a relatively small area, approximately 2000 sq ft, that contains end-dumped piles of incinerator ash and several Ramset pads.

4.1.3 Southeast Kettle Area

The kettle depression in the southeast corner of the site contains waste covering an approximately 15,000 sq ft area. The waste was dumped on the east bank of the kettle depression. The top of the disposal area was graded and covered with several inches of soil. Heavy building timbers comprise the greatest part of the waste. Hand-shovelled pits along the top of the kettle revealed: incinerator ash; concrete slabs; brick bats; and pieces of cast iron and steel. Twenty five, variably rusted-out 55 gallon drums were counted at the base of the kettle and buried in the timbers. None of the drums are intact. All but one drum are empty except for what appears to be small amounts of rain water in a few. One rusted out drum is nearly full of white hard crystalline material. Only one of the barrels had a legible label. The label on that drum indicated that the drum once contained trichloroethylene. This drum was empty except for about one inch of rainwater.

4.1.4 Pond C

Along the shore of Pond C by borings ERT 30 and ERT 31 less than 10 55-gallon drums lie partially submerged. They appear to have been once used as part of a floating dock. A 275 gallon domestic fuel-oil tank lies partially submerged midway between the island and the southern shore of Pond C.

4.2 Surficial Geology and Hydrogeology

The different types of sediment encountered in the borings and described in detail on the boring logs (Appendix A) are grouped below and identified according to their mode of deposition and compositional characteristics. The following subsections and figures describe the pattern of occurrence of the sediments, and the geological and hydrogeological characteristics of the site.

4.2.1 Site Surficial Geology

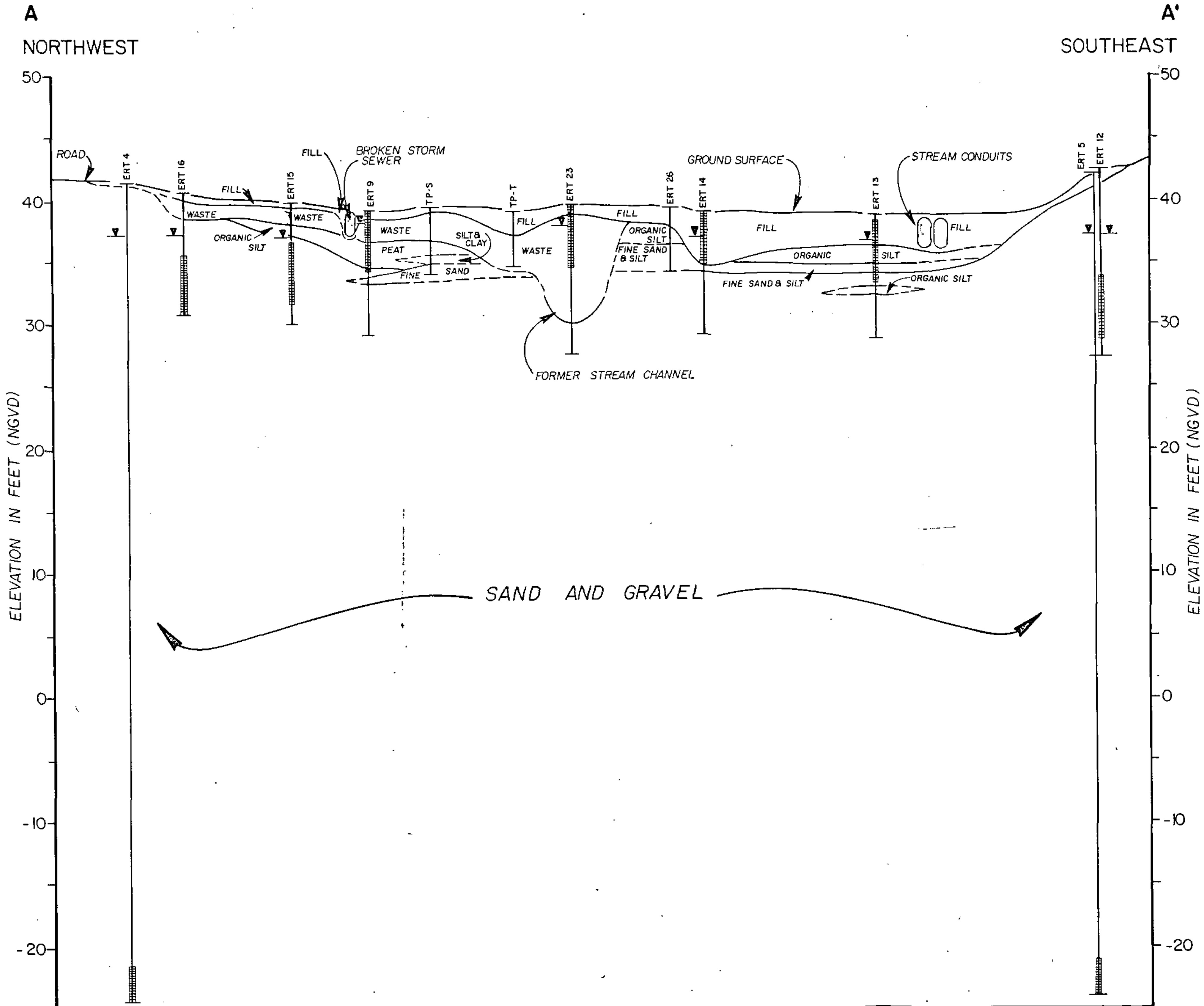
The general types of sediment encountered in the borings are described in order of their relative depth of occurrence from the ground surface down.

Fill

This unit is generally composed of locally derived sand and gravel with minor amounts of demolition rubble and incinerator waste. It underlies the greater part of the surface of the battery disposal area in thicknesses ranging from 0 ft to 5.0 ft (Figures 4-4 and 4-5). Generally, the fill occurs as a 1 ft to 2 ft thick veneer covering the underlying waste. It is thickest (4 ft to 5 ft) in the area of borings ERT 13 and ERT 14. Where the fill is absent the underlying waste appears at the surface, or the elevation of the land's surface rises and the glacio-fluvial sand and gravel unit crops out at the surface.

Waste

The waste unit is a heterogeneons mixture of incinerator ash, battery remains, wire, spent shotgun shells, demolition rubble, black



EXPLANATION

AUGERED BORING. HORIZONTAL BARS INDICATE TOP AND BOTTOM OF BORING. HACHURED RECTANGLE INDICATES ELEVATION AND LENGTH OF WELL SCEEN. GROUND-WATER ELEVATION INDICATED BY STANDARD SYMBOL; MEASUREMENTS TAKEN ON 25 MARCH 1982. ERT 1980 AND 1981.

TEST PIT. HORIZONTAL BARS INDICATE TOP AND BOTTOM OF PIT. ERT 1980.

CONTACT BETWEEN MAPPABLE UNITS. DASHED WHERE INFERRED.

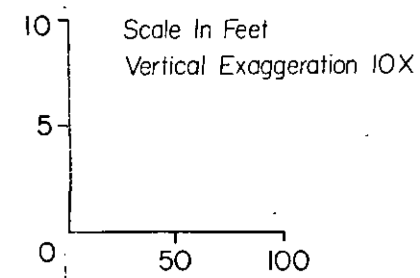
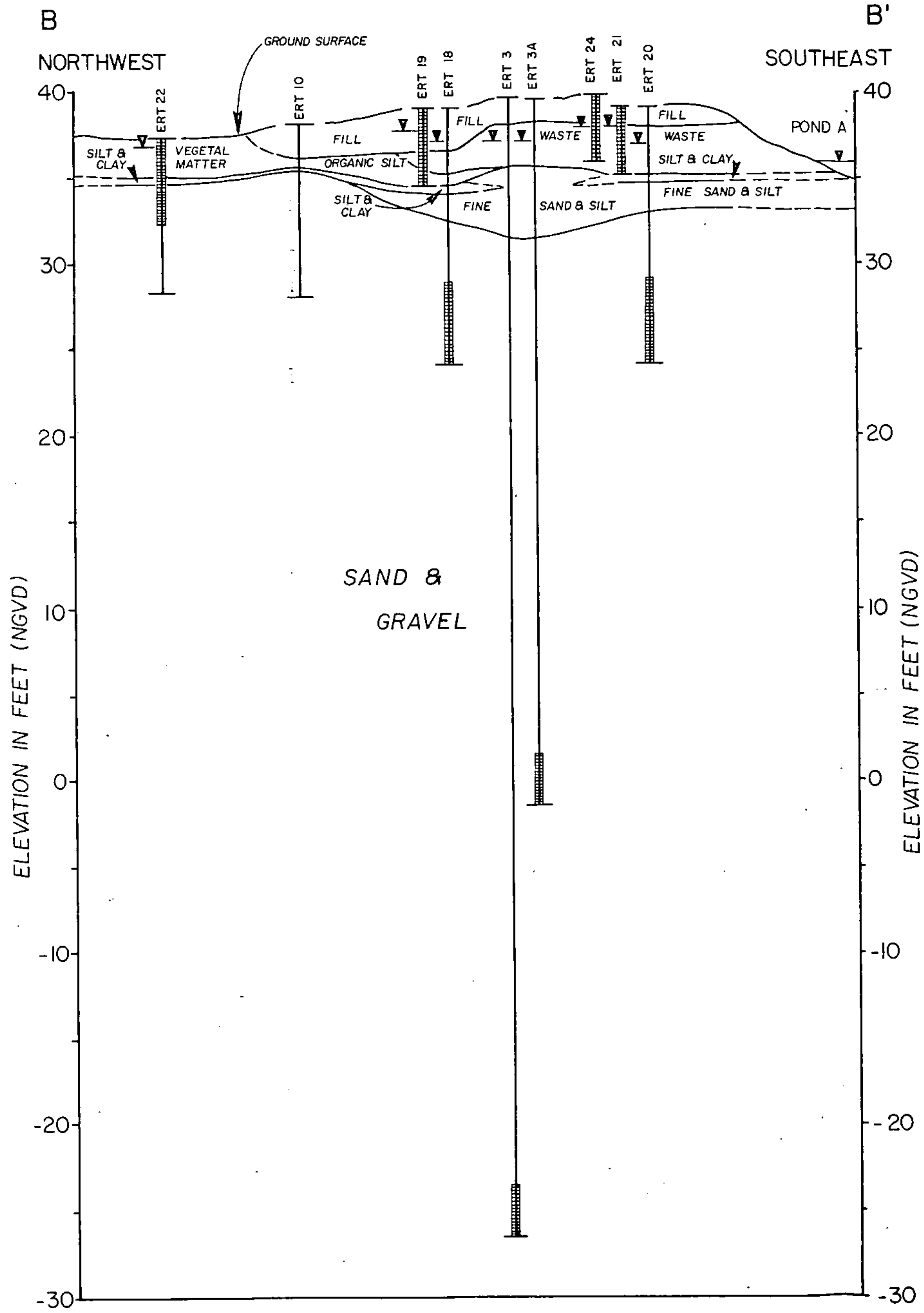


FIGURE 4-4 SURFICIAL GEOLOGIC CROSS SECTION A-A'



EXPLANATION

ERT 20

AUGERED BORING. HORIZONTAL BARS INDICATE ELEVATION OF TOP AND BOTTOM OF BORING. HACHURED RECTANGLE INDICATES LENGTH AND ELEVATION OF WELL SCREEN. GROUND-WATER ELEVATION INDICATED BY STANDARD SYMBOL; MEASURMENTS TAKEN 25 MARCH 1982. ERT 1980 AND 1981.

CONTACT OF MAPPABLE UNIT. DASHED WHERE INFERRED.

Scale In Feet

Vertical Exaggeration 10 X

10 5 0 50 100

FIGURE 4-5 SURFICIAL GEOLOGIC CROSS SECTION B-B' stained silt and sand, bottles, and textile materials. In the battery disposal area, waste occurs in thicknesses ranging from 0 ft to 8.5 ft. It appears to be absent southeast of ERT 26 at least along the alignment of cross section A-A' (Figure 4-4). Towards the northwest the waste unit pinches out (tapers to extinction) between ERT 4 and ERT 16. Between ERT 18 and Pond A, waste probably continues to the shore where refuse is visible at the surface. On Figure 3-1 the areal limits of waste containing battery remains are delineated.

Organic Silt and Peat

These sediments are composed of peat, a fibrous mat of sphagnum moss remains, and varying amounts of silt. The organic silt contains on the order of 50% partially decomposed plant matter. The term organic is a generalized term referring to the high content of plant material. This unit occupied the pond or swamp bottom prior to waste disposal and grading, and therefore is the uppermost natural deposit. Its thickness ranges from 0 ft to a maximum of 2.0 ft in the area of ERT 22. To the northwest the organic silt pinches out between ERT 15 and ERT 16, and to the southeast it pinches out between ERT 5 and ERT 13 (Figure 4-4). In the central part of the battery disposal area this unit is locally absent at: ERT 14; along the original course of the stream as observed in ERT 23, and probably in ERT 3 and ERT 3A; and between ERT 18 and Pond A (Figures 4-4 and 4-5). In boring ERT 13, a single lens of organic silt occurs within the underlying thick deposit of glacio-fluvial sand and gravel.

Silt and Clay

A thin layer, 0.5 ft thick, of gray silt and clay occurs at approximately elevation 35 ft across much of the battery disposal area on the shoreward side of the alignment of cross-section A-A' (Figures 4-4 and 4-5). It probably extends to the northwest beyond ERT 22, and to the southeast and northeast out under Pond A. This and the underlying fine sand and silt unit probably represent the initial post-glacial deposition in the kettle presently occupied by the battery disposal area and Pond A.

Fine Sand and Silt

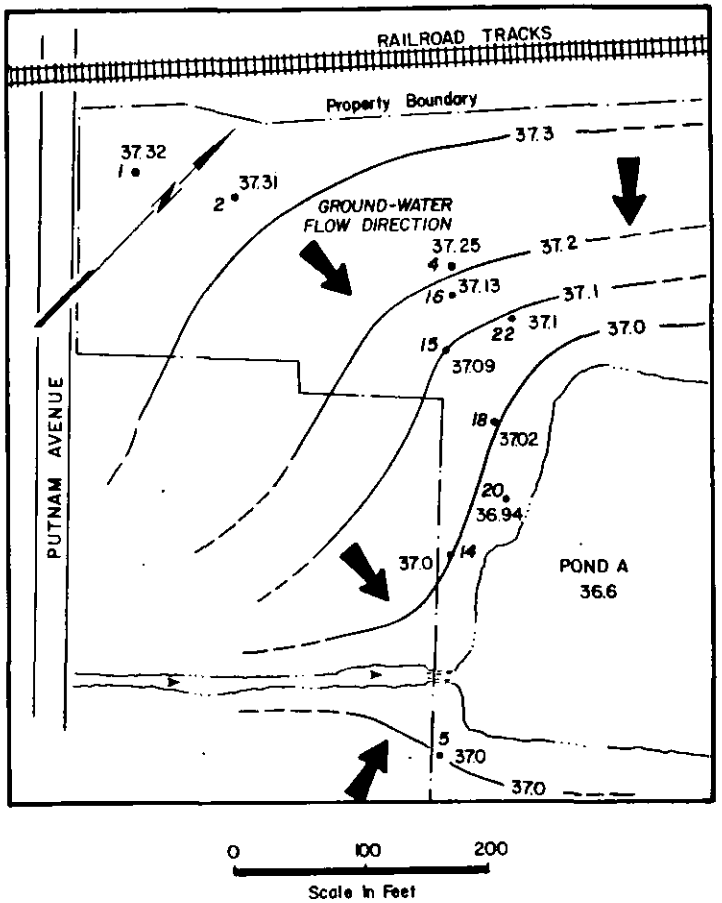
This unit composed of gray fine sand and silt underlies most of the battery disposal area between boring ERT 15 and ERT 5 (Figures 4-4 and 4-5). It ranges in thickness from 0 ft to 4 ft. Generally, this unit is found in a 1 ft to 2 ft thick layer overlying the thick deposit of glacio-fluvial sand and gravel. In the area of borings ERT 3 and ERT 3A where it is 4 ft thick, this unit may have been reworked by the stream that formerly coursed through the area prior to its having been channeled into the conduits immediately to the southwest of ERT 13.

Sand and Gravel

The sand and gravel unit appearing across the base of Figures 4-4 and 4-5 is a thick (approximately 100 ft) deposit of glacio-fluvial origin. This is a heavily tapped ground-water source in the site area. It constitutes the uppermost aquifer beneath the battery-disposal area.

4.2.2 Site Hydrogeology

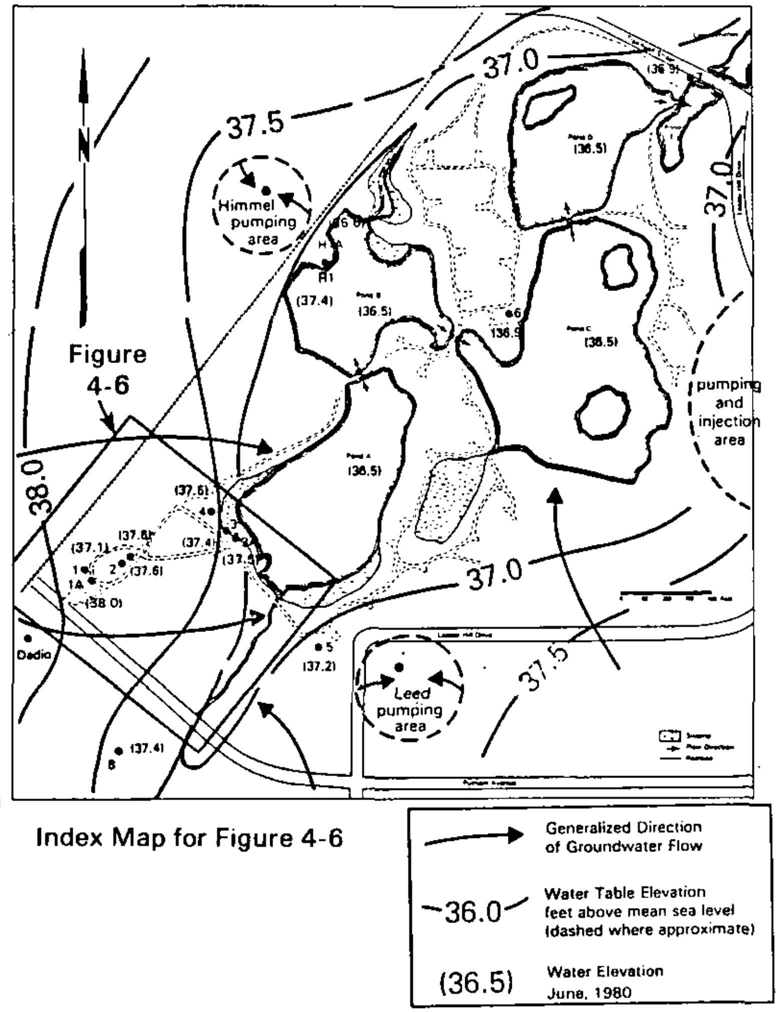
The Phase I investigation established that the aquifer in the Pine Swamp site is unconfined and consists of moderately to highly permeable sand and gravel up to 250 feet thick. The average gradient of the water table is about 0.0015 based on an approximate elevation difference between the ground-water divide and discharge area (ponds). Measurement of water levels in site wells on March 25, 1982 has generally confirmed this regional gradient. Figure 4-6 is a map of the potentiometric surface of the ground water near Pond A drawn from data collected on that day.



EXPLANATION

12 • 37.32 OBSERVATION WELL. GROUND-WATER ELEVATION GIVEN IN FEET. MARCH 25, 1982.

37.1 GROUND-WATER ELEVATION CONTOUR LINE. CONTOUR INTERVAL 0.1 FEET



Index Map for Figure 4-6

Figure 4-6 Regional Ground-Water Contour Map

The existence of a lens of perched ground water has been noted from measurement of water levels in several of the new shallow wells. The perched water occurs in wells screened above a thin layer of fine silt and clay observed at an approximate depth of 5 feet. Perched water conditions account for higher than expected water elevations observed in ERT-9, 17, 19, 21, 23, and 24. The cross section in Figure 4-7 shows the relationship of the perched water to the regional aquifer. The gradient between the perched water and Pond A is approximately 0.03.

4.3 Evaluation of Soil Analytical Data

Eighteen soil samples from 9 borings were analyzed to assess the potential for leaching of cadmium, chromium, lead, mercury, manganese and zinc from the waste buried on site. The rationale for the selection of the anlaytical samples appears on Table 4-2. The rationale was established to determine the concentration of metals that are leachable by an aggressive leachate medium of pH 5 that is prescribed in EPA's EP toxicity test. Table 4-3 lists the on-site background concentrations for soil. Table 4-4 lists the EP toxicity metal concentrations specified by EPA.

The soil samples that were subjected to the EP toxicity test fell into 3 general categories that relate to their being waste, soil from below the waste, or soil not below the waste. The waste was analyzed to determine the characteristics of the parent material of the potential leachate. Sediments below the waste were analyzed to assess the amount of leaching that has taken place. The analyses from these sediments are compared to analyses of sediments from areas not overlain by waste which are, therefore, representative of on-site background conditions. Other samples were chosen to fill out the vertical concentration gradients at depth below the waste as determined for borings ERT 9, ERT 11 and ERT 23 (Figure 4-8). Table 4-5 details the categories of the samples subjected to EP toxicity tests, and lists the analytical results. One bottom sediment sample from Pond A was subjected to total metals concentration

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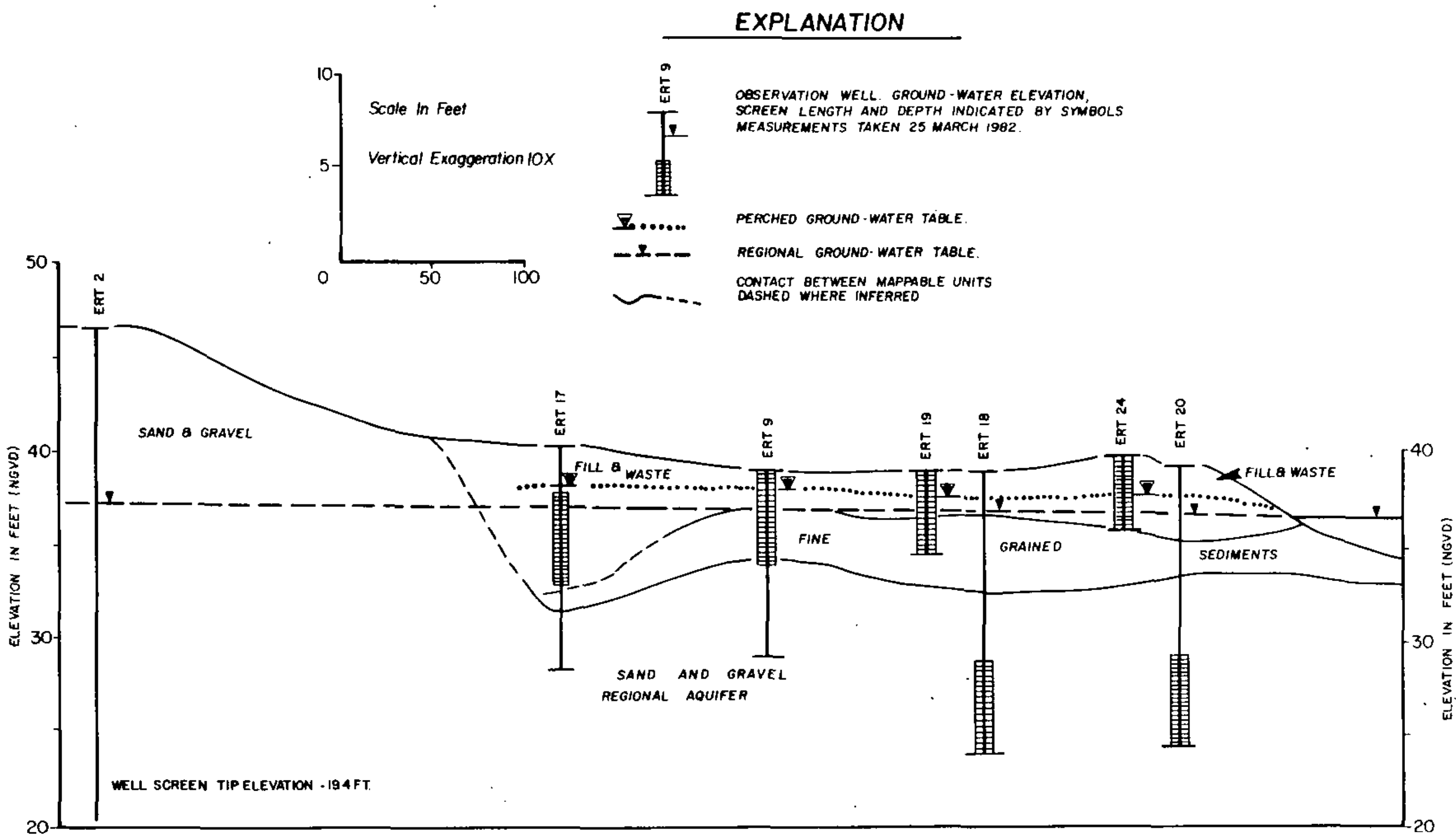


Figure 4-7 Ground-Water Cross Section

TABLE 4-2

RATIONALE FOR SOIL ANALYSES

General Soil Description	Sample Description	
	Boring No.	Sample No.
Waste Containing Battery Remains	ERT 9	SS2
	ERT 11	SS3
	ERT 18	SS2
	ERT 20	SS1A
	ERT 23	SS1A
Peat or Organic Silt Below Waste	ERT 9	SS3
	ERT 11	SS3A
	ERT 17	SS4
	ERT 18	SS3
	ERT 20	SS3
Peat or Organic Silt <u>Not</u> Below Waste	ERT 10	SS2A
	ERT 13	SS4
	ERT 22	SS2
Other Deposits Below Waste		
Sand & Gravel	ERT 9	SS5
Sand & Gravel	ERT 23	SS4
Organic Silt	ERT 17	SS3B
Textile Waste	ERT 23	SS3B
Sand & Gravel	ERT 23	SS3C
Pond Bottom Sediments	Pond A	2

TABLE 4-3

ON-SITE BACKGROUND CONCENTRATIONS

FOR SOIL DETERMINED BY EP TOXICITY TEST

Constituent	Concentration (ppm)
Cadmium	ND
Chromium	ND
Hexavalent Chromium	ND
Lead	ND
Manganese	1.2-1.6
Mercury	ND
Zinc	ND-1.9

Notes:

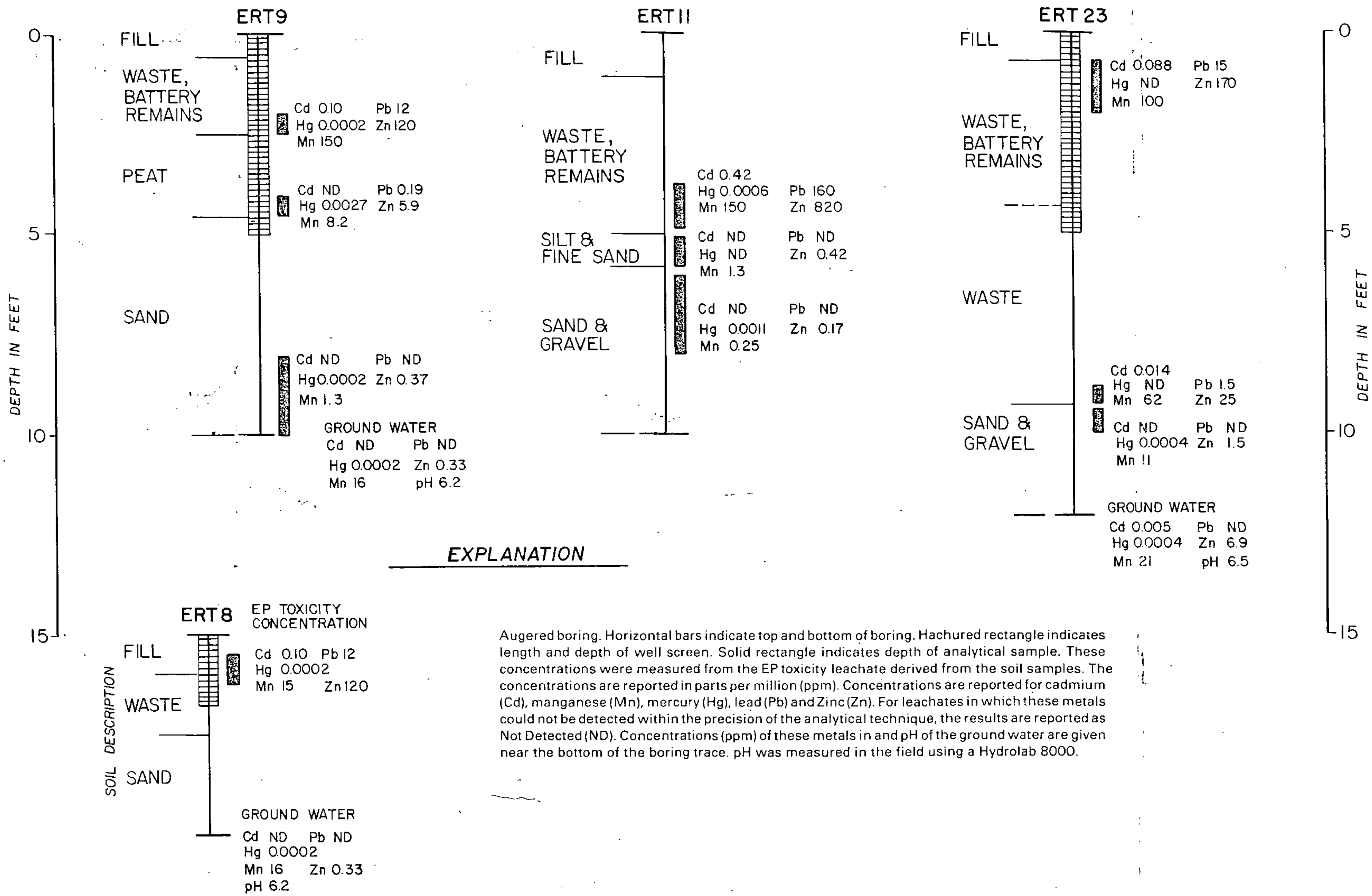
1. ND - not dectected.
2. Background concentrations ranges are derived from values considered most representative of soil not below waste; See Table 4-5

TABLE 4-4

METAL CONCENTRATIONS SPECIFIED BY EPA FOR CHARACTERIZATION AS A HAZARDOUS WASTE (EP TOXICITY TEST)

Metal	Concentration (ppm)
Cadmium (Cd)	1.0
Hexavalent Chromium (Cr^{+6})	5.0
Lead (Pb)	5.0
Mercury (Hg)	0.2

Source: Federal Register V45 No. 98
Monday May 19, 1980
p. 33122



EXPLANATION

Augered boring. Horizontal bars indicate top and bottom of boring. Hachured rectangle indicates length and depth of well screen. Solid rectangle indicates depth of analytical sample. These concentrations were measured from the EP toxicity leachate derived from the soil samples. The concentrations are reported in parts per million (ppm). Concentrations are reported for cadmium (Cd), manganese (Mn), mercury (Hg), lead (Pb) and Zinc (Zn). For leachates in which these metals could not be detected within the precision of the analytical technique, the results are reported as Not Detected (ND). Concentrations (ppm) of these metals in and pH of the ground water are given near the bottom of the boring trace. pH was measured in the field using a Hydrolab 8000.

Figure 4-8 Graphic Boring Logs and Metal Concentrations

TABLE 4-5

CONCENTRATIONS IN THE EXTRACT FROM EP TOXICITY TEST (mg/l)

ERT Lab No.	Boring No.	Sample No.	Sample Depth	Cd	Cr	Cr^{+6}	Hg	Mn	Pb	Zn	pH
Waste Containing Batteries											
11999	ERT9	SS2	2.0-4.0	0.10	ND	ND	0.0002	150	12	120	6.4
11997	ERT11	SS3	4.0-5.0	0.42	ND	ND	0.0006	150	160	820	7.2
11991	ERT18	SS2	2.5-4.5	1.2	ND	ND	0.0002	170	14	1000	9.4
11989	ERT20	SS1A	1.3-2.0	0.16	ND	ND	ND	140	1.2	170	7.4
11985	ERT23	SS1A	0.7-2.0	0.088	ND	ND	ND	100	15	170	7.2
Textile Waste											
11986	ERT23	SS3B	8.8-9.3	0.014	ND	ND	ND	62	1.5	25	7.4
Peat or Organic Silt Below Waste											
12000	ERT9	SS3	4.0-6.0	ND	ND	ND	0.0027	8.3	0.19	5.9	6.7
11996	ERT11	SS3A	5.0-6.0	ND	ND	ND	ND	1.3	ND	0.42	7.3
11994	ERT17	SS3B	7.0-7.2	ND	ND	ND	ND	12	0.25	0.13	5.8
11993	ERT17	SS4	8.0-8.5	ND	ND	ND	ND	0.92	ND	0.21	6.6
11990	ERT18	SS3	4.0-4.5	0.081	ND	ND	0.0003	130	0.48	150	6.8
11988	ERT20	SS3	4.0-4.3	ND	ND	ND	ND	8.5	ND	2.7	7.5
Sand and Gravel Below Waste											
12001	ERT9	SS5	8.0-10.0	ND	ND	ND	0.0002	1.3	ND	0.37	8.0
1995	ERT11	SS4	6.0-8.0	ND	ND	ND	0.0011	0.25	ND	0.17	8.2
1987	ERT23	SS3C	9.3-10.0	ND	ND	ND	0.0004	11	ND	1.5	8.3

TABLE 4-5 (Continued)

ERT Lab No.	Boring No.	Sample No.	Sample Depth	Cd	Cr	Cr+6	Hg	Mn	Pb	Zn	pH
Peat or Organic Silt Not Below Waste											
11998	ERT10	SS2A	2.8-3.0	0.023	ND	ND	ND	48	0.19	48	7.4
11992	ERT13	SS4	6.0-6.5	ND	ND	ND	ND	1.2	ND	1.9	8.4
11984	ERT22	SS2	2.0-2.3	ND	ND	ND	ND	1.6	ND	ND	7.8
Detection Limit				0.005	0.05	0.01	0.0002	0.01	0.10	0.005	

Note: Concentrations are reported in milligrams per liter (mg/l). These units are equivalent to parts per million (ppm).

analyses and the results are compared to published typical metals concentrations found in naturally occurring soil and total metals concentrations measured in bottom sediments from nearby reservoirs. Table 4-6 shows this comparison.

The following subsections discuss the results of the analyses for each constitutent.

4.3.1 Cadmium

Cadmium concentrations in the leachate generated in the EP toxicity test run on the samples of waste containing battery remains ranged from 0.014 ppm to 1.2 ppm. The concentration of 1.2 ppm cadmium measured in a sample of waste containing battery remains from boring ERT 18 exceeds EPA's criteria for characterization as a hazardous waste by 0.2 ppm. The ambient pH in this sample, however, was measured at 9.4. This ambient pH represents a concentration of hydrogen ions that is more than 4 orders of magnitude less than that present in the EP toxicity leachate generating medium. Therefore, the EP toxicity medium far more aggessively strips the waste of metal ions than the ambient pore fluid.

Cadmium was detected in only 2 of the 12 samples of natural sediment. Sample SS3 from boring ERT 18 produced the highest cadmium concentration in this sample category (0.081 ppm). This sample is also comparatively high in concentrations of other metals by 1 to 2 orders of magnitude when compared to the other samples of natural sediments that underlie the waste. Although this is possibly the result of leaching, it more likely suggests that this sample may have been mechanically contaminated by the split-spoon sampler which could have smeared the sample with waste that had fallen into the bottom of the boring between sampling rounds. Sample SS2A from boring ERT 10 produced a leachate that is comparatively high in all metals by an order of magnitude when compared to the other samples of natural sediment. There was no evidence of battery remains detected in the boring and the data provide no explanation for this anomalous occurrence.

TABLE 4-6

METAL CONCENTRATIONS IN BOTTOM SEDIMENTS (ppm)

Metal	Concentration Range in Lakes Whitney & Saltonstall[1]	Concentration in Pond A
Cadmium (Cd)	1-2.7	1.2
Chromium (Cr)	70-100	19
Lead (Pb)	600-1100	62
Manganese (Mn)	1500-2300	150
Mercury (Hg)[2]	0.01-0.3	0.20
Zinc (Zn)	350-650	550

1 Bertine and Mendick (1973).
2 Bowen (1966).

Figure 4-8 schematically portrays three borings from which a suite of samples was analyzed to determine the change in leachable metals concentrations between the waste and underlying sediments. Examination of the metals concentrations listed for each sample and correlation of the concentrations with the type of soil analyzed reveals two general conclusions: (1) the battery waste is enriched in the metals noted on the figure; and (2) the sediments below the waste are not receiving leachable concentations of metals from the waste as seen in the distinct and abrupt drop in concentrations in the sediments. Furthermore, the metals concentrations measured in the ground water from the waste in ERT 9 and ERT 23, if detected, are only slightly elevated (Section 4.4.1). These results imply that cadmium is not detectably leaching from the waste into the underlying sediment.

4.3.2 Chromium and Hexavalent Chromium

No chromium or hexavalent chromium was detected in any of the leachates generated from the samples of waste or natural sediments.

4.3.3 Mercury

Eight of the soil samples produced leachates in which mercury was detected. All but two of these mercury concentrations were very low, less than 3 times the detection limit. The two highest concentrations (0.011 ppm and 0.027 ppm) were derived from samples of natural soil that underlie battery waste. In both cases the overlying waste contained detectable concentrations of mercury. We cannot conclusively state that mercury is not leaching, however, the presence of mercury in the underlying natural sediments in concentrations greater than that found in the overlying waste suggests that the mercury was introduced into the natural sediments by mechanical contamination during the drilling and sampling operation rather than it having been a result of leaching from the overlying waste. Many of the samples when extracted were smeared with the black waste and could not be completely trimmed in the field. The concentrations of mercury derived from samples of waste containing battery remains were, at their greatest, 2 orders of magnitude less than the concentration required to satisfy the EPA hazardous waste characterization criterion. Therefore, mercury appears to be of little threat to the quality of surface water or ground water.

4.3.4 Manganese

The on-site background EP toxicity concentration for manganese as determined from borings ERT 13 and ERT 22 ranges between 1.2 ppm to 1.6 ppm. Samples of the battery waste produced EP toxicity leachates that contained concentrations of manganese that are 2 orders of magnitude greater than the on-site background concentrations. The EP toxicity leachates derived from samples of natural sediment that underlie the battery waste contained 1 to 2 orders of magnitude less manganese than the battery waste (Figure 4-8 and Table 4-5). These concentrations, however, are greater than the on-site background concentrations. There are two reasons which indicate that leaching of manganese from the battery waste into the natural sediments cannot be reliably inferred, and that any elevated manganese concentration found in the natural sediments is more likely the result of mechanical contamination that occurred during sampling. One, there is a relatively small difference between manganese concentrations found in the natural sediments underlying the battery waste and the on-site background concentration. In addition, four of the manganese concentrations from the natural sediments are within or below the on-site background concentration range.

4.3.5 Lead

Lead concentrations generated in the EP toxicity leachates from samples of the battery waste and from waste textiles (sampled in boring ERT 23) ranged from 1.2 to 160 ppm. This broad range of concentrations is indicative of the heterogeneous nature of the waste. Four of the 5 battery waste samples satisfy the EP toxicity hazardous waste characterization criterion for lead. The ambient pH measured in these samples, however, ranged from 6.4 to 9.4. When compared to the EP toxicity leachate-generation medium pH of 5 it can be seen that the hydrogen ion concentration in the leachate-generation medium was 1.4 to 4.4 orders of magnitude greater than that measured in the battery-waste samples. Therefore, the leachate generation medium was far more potent in its ability to strip the waste of lead.

The on-site EP toxicity background concentration of lead is not detectable. Six of the 9 samples of natural sediment produced EP toxicity leachates in which lead could not be detected. The elevated lead concentrations were measured in leachates from samples that contain elevated concentrations of most other metals. This implies that the samples probably represent mechanical contamination rather than evidence of detectable leaching. Figure 4-8 depicts the distinct and abrupt drop in leachable lead concentrations in the natural sediments below the waste. This generally indicates that lead is not detectably leaching.

4.3.6 Zinc

Zinc concentrations measured in the EP toxicity leachate generated from the six samples of waste ranged through 2 orders of magnitude from 25 ppm (obtained from the textile in boring ERT 23) to 1000 ppm. These concentrations exceed the on-site background EP toxicity leachate concentrations by 1 to 3 orders of magnitude. Six of the nine samples of natural sediment that were extracted from beneath battery waste produced EP toxicity leachate that contained zinc concentrations falling within the on-site background concentration range of ND to 1.9 ppm. Two of these concentrations from ERT 9 and ERT 20 exceed the background concentration by less than 3 times. The concentration of 150 ppm measured in the leachate from sample SS2 in boring ERT 18 is consistent with the generally elevated concentrations of the other metals, and indicates that this sample was probably mechanically contaminated. These data and the abrupt drop in concentrations depicted on Figure 4-8 indicate that zinc is probably not detectably leaching into the underlying sediments.

4.3.7 Soil pH

The ambient soil pH measured in samples of waste ranged from 6.4 to 9.4. Four of the six waste samples yielded pH measurements of 7.2 to 7.4. The samples of peat or organic silt taken from below the waste tended to have lower pH values (5.8 to 7.3) than the samples of sand and gravel taken from below the waste (7.5 to 8.2). The three samples of organic silt taken from borings in which no waste was found produced pH readings of 7.4 to 8.4. These ambient pH values are generally 2.5 pH units above the EP toxicity leachate pH of 5. This represents a 2.5 orders of magnitude greater concentration of hydrogen ions in the EP toxicity leachate medium used to generate the metals concentrations discussed in the previous sections.

4.3.8 Pond A Bottom Sediment

A sample taken from approximately 10 feet offshore on Pond A (Figure 3-1) was subjected to a total analysis for cadmium, chromium, mercury, manganese, lead, zinc and pH. These analyses were conducted to assess the metals content of the sediment in comparison to published ranges of typical metals concentrations in bottom sediment primarily from Lakes Whitney and Saltonstall. Table 4-6 presents the metals concentrations. Bowen (1966) was used for the mercury concentration range since local bottom sediments were not analyzed for this metal. In each case, the metal concentration in Pond A bottom sediment is below or within the published concentration range. Therefore, the contribution of metals to Pond A from the battery waste has not increased bottom sediment concentrations above expected levels.

4.4 Evaluation of Ground-Water Quality

Water samples from 23 wells were analyzed for six metals (cadmium, chromium, mercury, manganese, lead, and zinc). Those wells sampled included the Davenport Lab and Whitney Center south well. Based upon the well location, the analytical results can be described in three categories: perched ground water, regional aquifer below waste, and regional aquifer not below waste. Tables 4-7, 4-8 and 4-9 present the results of metals analyses for samples within each of these categories.

The following subsections discuss the results of the analyses for each constituent.

4.4.1 Metals

Cadmium

Cadmium was detected in only three of the 23 water samples analyzed. None of the on-site wells in the regional aquifer was found to contain cadmium, while ERT 14 (in the regional aquifer below waste) contained cadmium at the detection limit (0.005 ppm). Two wells screened in perched water in the battery waste contained cadmium. The concentration in ERT 23 was 0.005 ppm, while in ERT 24 the concentration was 0.006 ppm. Thus, although cadmium was detected in low concentrations in two shallow ground-water samples, the metal does not appear to be migrating into the deeper aquifer.

Chromium

No chromium was detected in any of the ground-water samples.

Mercury

Nine of the ground-water samples contained detectable concentrations of mercury. All but two of the these mercury concentrations were very low, within two times the detection limit. It is unusual that the highest mercury concentration (0.0012 ppm) was detected in the sample from ERT 7, which is the deep well near the outlet of Pond D. The data do not provide an explanation for this anomalous occurrence.

TABLE 4-7

METAL CONCENTRATIONS IN PERCHED GROUND WATER (mg/l)

ERT Lab No.	Well No.	Screen Depth	Cd	Cr	Hg	Mn	Pb	Zn	pH
11968	9	5	ND	ND	0.0002	16	ND	0.33	6.3
11971	17	7	ND	ND	ND	0.82	0.18	0.25	6.5
11973	19	5	ND	ND	0.0002	2.9	ND	0.91	7.2
Not sampled	21								
11976	23	5	0.005	ND	0.0004	21	ND	6.9	6.9
11977	24	4	0.006	ND	0.0003	17	ND	1.2	7.3
Detection Limit			0.005	0.05	0.0002	0.01	0.10	0.005	

Notes:

1. pH was measured in the field using a Hydrolab 8000.
2. Concentrations are reported in milligrams per liter (mg/l). These units are equivalent to parts per million (ppm).

TABLE 4-8

METAL CONCENTRATIONS IN REGIONAL AQUIFER

BELOW WASTE (mg/l)

ERT Lab No.	Well No.	Screen Depth	Cd	Cr	Hg	Mn	Pb	Zn	pH
11962	3	65	ND	ND	ND	0.41	ND	0.007	7.8
11960	3A	35	ND	ND	ND	0.30	ND	0.036	7.5
11965	13	5	ND	ND	ND	0.54	ND	0.23	6.7
11967	14	4	0.005	ND	0.0003	1.3	ND	1.6	5.9
11969	15	8	ND	ND	ND	1.0	ND	0.021	6.8
11970	16	10	ND	ND	0.0002	5.8	ND	0.007	6.6
11972	18	15	ND	ND	ND	0.021	ND	0.012	7.0
11974	20	15	ND	ND	0.0004	6.8	ND	0.10	6.7
11975	22	5	ND	ND	0.0002	0.14	ND	0.017	6.8
Detection Limit			0.005	0.05	0.0002	0.01	0.10	0.005	

Notes:

1. pH was measured in the field using a Hydrolab 8000.
2. Concentrations are reported in milligrams per liter (mg/l). These units are equivalent to parts per million (ppm).
3. ERT 13 and ERT 14 are screened in fill, but the silt and clay layer is absent at both locations. Thus water elevations reflect that of the regional aquifer.

TABLE 4-9

METAL CONCENTRATIONS IN REGIONAL AQUIFER

NOT BELOW WASTE (mg/1)

ERT Lab No.	Well No.	Screen Depth	Cd	Cr	Hg	Mn	Pb	Zn	pH
11958	4	60	ND	ND	ND	0.37	ND	0.018	6.9
11959	5	65	ND	ND	ND	3.2	ND	0.005	7.1
11980	7	60	ND	ND	0.0012	ND	ND	0.017	6.9
11978	12	13	ND	ND	ND	0.68	ND	0.052	6.7
11979	29	25	ND	ND	ND	0.12	ND	0.022	6.6
11983	30	12	ND	ND	ND	0.056	ND	0.014	6.6
11982	31	9	ND	ND	ND	0.014	ND	0.015	6.5
11981	Whitney[1]	NA	ND	ND	ND	ND	ND	0.021	NA
11961	Davenport	NA	ND	ND	ND	0.72	ND	ND	7.1
Detection Limit			0.005	0.05	0.0002	0.01	0.10	0.005	

Notes:
1. Field measurements could not be taken nor could sample be filtered due to discharge configuration of the well.
2. pH was measured in the field using a Hydrolab 8000.
3. Concentrations are reported in milligrams per liter (mg/l). These units are equivalent to parts per million (ppm).

Manganese

Manganese was detected in all but two (ERT 7 and Whitney Center south) of the ground-water samples. The background concentrations in the regional aquifer ranged from less than the detection limit to 3.2 ppm. Manganese concentrations in samples from the regional aquifer below the waste ranged from 0.021 to 6.8 ppm. Perched ground-water samples exhibited manganese concentrations ranging from 0.82 to 21 ppm or approxmately 7 times the on-site background concentration. However, a 1970 survey of 36 wells in the Quinnipiac River basin showed that manganese concentrations ranged from 0.0 to 5.9 ppm (Mazzaferro, Handman, and Thomas 1979). This range is similar to that found in samples collected from the regional aquifer below the waste. Only ERT 20 has a higher concentration of manganese (6.8 ppm) than the published range. These results imply that manganese is leaching into the shallow ground water from the waste materials, but is not migrating into the regional aquifer near Pond A in significant concentrations. Manganese was not detected in ERT 7 which is screened in the regional aquifer at the north end of the site (near the Pond E outlet).

Lead

Lead was detected in only one ground-water sample. The sample from ERT 17, which is screened in the perched ground water, contained 0.18 ppm lead. Thus, lead is not leaching into the regional aquifer.

Zinc

All but one ground-water sample contained detectable concentrations of zinc. On-site background samples had zinc concentrations ranging from not detected to 0.052 ppm. Zinc concentrations in samples from the regional aquifer below waste ranged from 0.007 to 1.6 ppm. Samples from perched ground water had zinc concentrations ranging from 0.15 to 6.9 ppm. These data suggest that zinc is leaching into perched ground water from the battery waste.

Zinc concentrations in the regional aquifer below waste are also slightly elevated above on-site background zinc concentrations. However, the highest concentration of zinc in the samples from the aquifer below the waste was in ERT 14, which is screened at 4 feet below the surface. Of the wells screened below 10 feet, the concentration of zinc ranges from 0.007 to 0.10 ppm. Thus, zinc appears to be migrating from the perched ground water into the shallow portion of the regional aquifer but not into deeper portions. The concentration of zinc in ERT 7 (near the outlet of Pond E) was 0.017 ppm.

4.4.2 Organic Compounds

Seventeen ground-water samples were analyzed for the volatile priority pollutant organics, 13 for the base/neutral fraction, and three for the acid-extractable and pesticides fractions. Samples from the same 17 locations which were analyzed for the volatile fraction were also analyzed for several non-priority pollutants in an attempt to identify the source of odors noticed in some wells. Tables 4-10 and 4-11 present the results of these organic compound analyses. A discussion of these results is given in the following two sections.

Organic Compounds in Ground Water near Pond A

The concentrations of all organic priority pollutants detected were less than 39 ppb in ground-water samples collected from wells located in the vicinity of the battery and burned waste near Pond A. At ERT 24, which is screened in the perched ground water, 39 ppb toluene was detected. Toluene was not detected in any other water sample. Fluoranthene was the only other organic priority pollutant compound detected in a sample from the perched ground water (22 ppb at ERT 17).

Four organic priority pollutant compounds were detected in samples from wells screened in the regional aquifer below waste. Tetrachloroethylene was detected at 14 ppb and 16 ppb in ERT 3A and

TABLE 4-10

RESULTS OF EPA PRIORITY POLLUTANT SCANS
FOR ORGANIC COMPOUNDS IN GROUND WATER

Sample Location	Concentration (ug/l)	Constituent
ERT 2	20	1,1-dichloroethylene
ERT 3	20	1,1-dichloroethylene
ERT 3A	10	trans-1,2-dichloroethylene
	14	tetrachloroethylene
ERT 17	22	fluoranthene
ERT 20	16	1,2-dichloroethane
	16	tetrachloroethylene
ERT 24	39	toluene
ERT 29	70	trans-1,2-dichloroethylene
	58	trichloroethylene
	85	tetrachloroethylene

Notes:

1. Results are reported for analyses that showed concentrations for the constituent tested for that were above the detection limit. All other constituents were not detected in concentrations above the detection limit.
2. Concentrations are reported in micrograms per liter (ug/l). These units are equivalent to parts per billion (ppb).

TABLE 4-11

NON-PRIORITY POLLUTANT ORGANIC COMPOUNDS

DETECTED IN GROUND-WATER SAMPLES

Sample Location	Constituent Concentrations (~~ug/l~~) PPM			
	Acetone	Tetrahydrofuran	Ethyl Ether	Tertiary-Butyl Alcohol
ERT 2	ND	200	ND	ND
ERT 2A	ND	95	ND	ND
ERT 3	ND	150	ND	5300
ERT 3A	~~.2~~ 200	120	ND	670
ERT 15	~~.6~~ 570	50	ND	ND
ERT 16	220	1300	ND	ND
ERT 17	ND	320	ND	350
ERT 20	ND	30	~~3~~ 300	700
Davenport	ND	45	ND	890

Notes: 1. Concentrations are reported in micrograms per liter (ug/l). These units are equivalent to parts per billion (ppb).

2. In this table, ND signifies that a peak was not apparent in the GC/MS scan.

ERT 20, respectively. 1,1-dichloroethylene was detected at 20 ppb in ERT 3 and 1,1-dichloroethane was detected in ERT 20 at 16 ppb. Trans-1,2-dichloroethylene at 10 ppb was also detected in ERT 3A. The only organic priority pollutant compound detected in a sample from an on-site background well (ERT 2) was 1,1-dichloroethylene at 20 ppb.

None of these organic compounds can be traced to a particular source. Most of the compounds identified are common industrial and commercial degreasing or extraction solvents.

Of the non-priority pollutant organics detected in samples from wells near Pond A, tetrahydrofuran and tertiary-butyl alcohol were most prevalent and in the highest concentrations (Table 4-11). Tetrahydrofuran, a solvent having an ethereal odor, was detected in concentrations ranging from approximately 45 to 1,300 ppb. The highest concentration was detected at ERT 16, which may imply a source near this well. Tertiary-butyl alcohol, an alcohol denaturant with a camphor odor, was detected in five samples in concentrations ranging from approximately 350 to 5300 ppb. No source can be identified for this organic compound since the highest concentration was detected in ERT 3 which is screened at a depth of 65 feet in the regional aquifer. Both of these organics were detected in the Davenport well, which probably accounts for odors in the water from that well. Acetone, which has a sweetish odor was detected in three samples, while ethyl ether was detected in one sample. These four non-priority pollutant organics probably account for any odors noticed in the on-site wells near Pond A.

In conclusion, several organic priority pollutants have been detected in samples from the perched and regional aquifers. However the concentrations detected were less than 39 ppb. A specific source cannot be determined for any of the compounds, which are all common indusrial and commercial degreasing or extraction solvents. No organic priority pollutants were detected in the sample from ERT 7, which is screened in the regional aquifer near the outlet of Pond E. Odors noticed in the water from certain upgradient wells at the site are due to the presence of several non-priority pollutant organics, most notably tetrahydrofuran and tertiary-butyl alcohol.

Organic Compounds in Ground Water near Southeast Kettle Area

Three volatile priority pollutant organics were detected in ERT 29, which is located at the base of the pile of demolition rubble in the kettle. The volatile organics detected in ERT 29 were trans-1,2-dichloroethylene (70 ppb), trichloroethylene (58 ppb), and tetrachloroethylene (85 ppb). Although the source of these organics may be the rusty drums in the kettle (one drum is labeled trichloroethylene), no organics were detected in samples from the two wells downgradient from the kettle (ERT 30 and ERT 31). Thus, there is no indication that any organic priority or non-priority pollutants are entering Pond C as a result of waste disposed of in the kettle area. In addition, no organic compounds were detected in the Whitney Center south well.

4.5 Evaluation of Surface-Water Quality

Five surface-water samples were analyzed for six metals (cadmium, chromium, mercury, manganese, lead, and zinc). The locations at which the surface-water samples were collected are shown on Figure 3-1 (in pocket). Additionally, the sample collected from Pond E was analyzed for the volatile and base/neutral priority pollutant organics. Results of these analyses for the volatile and base/neutral priority pollutant organics are shown on Table 4-12. The following subsections discuss the results of these analyses.

4.5.1 Metals

No cadmium, chromium, mercury, or lead was detected in any of the surface-water samples. Manganese and zinc were detected in each sample, although concentrations of all but one sample (SW-4) were less than 0.53 ppm for manganese and 0.22 ppm for zinc. SW-4 contained 1.9 ppm manganese and 5.2 ppm zinc. This sample was collected from Pond A between ERT 18 and ERT 24. The source of the manganese and zinc may be the discharge of perched ground water into Pond A containing slightly elevated concentrations of manganese and zinc, or

TABLE 4-12

ANALYTICAL RESULTS FOR SURFACE WATER SAMPLES

Metals (mg/l)

ERT Lab No.	Sample No.	Sample Location	Cd	Cr	Hg	Mn	Pb	Zn	pH
12718	SW-1	brook at Putnam Ave.	ND	ND	ND	0.44	ND	0.22	7.3
12719	2	brook at Pond A	ND	ND	ND	0.53	ND	0.14	7.6
12720	3	Pond A at brook	ND	ND	ND	0.45	ND	0.13	7.0
12721	4	Pond A near ERT-18	ND	ND	ND	1.9	ND	5.2	6.8
12722	5	Pond E at Treadwell	ND	ND	ND	0.14	ND	0.033	6.9
Detection limit			0.005	0.05	0.0002	0.01	0.10	0.005	

Organic Compounds (ug/l)

Sample No.	Concentration	Constitutent
SW-5	11	1,1,1-trichloroethane
Detection Limit	10	

Notes:
1. Metal concentrations are reported in milligrams per liter (mg/l). These units are equivalent to parts per million (ppm).
2. Organic compound concentrations are reported in micrograms per liter (ug/l). These units are equivalent to parts per billion (ppb).

it may be related to the street-drain discharge near ERT 9. However, the lowest manganese and zinc concentrations were detected at the outflow of Pond E (SW-5). This indicates that any elevated concentrations of manganese or zinc that might enter Pond A via surface runoff are being trapped within the pond system and are not leaving Pond E via the outlet to Lake Whitney.

4.5.2 Organic Compounds

A surface-water sample was collected near the outlet of Pond E, and was analyzed for volatile and base/neutral organics. This sample (SW-5) was found to contain 11 ppb 1,1,1-trichloroethane, which was not detected in any of the ground-water samples. This organic compound had been previously detected during the Phase I investigation in ground-water samples from the Leed well and ERT 5. An off-site source was suggested for these occurrences since these wells were upgradient from any disposal areas on the Pine Swamp site. It is important to note that the detection limit for analysis of 1,1,1-trichloroethane is 10 ppb. In addition, the ambient water quality criterion for 1,1,1-trichloroethane (which has not been found to be carcinogenic) is 18.4 ppm. (EPA, 1980).

4.6 Estimate of Contaminant Input to Pond System

4.6.1 Shallow Ground-Water Input Through Battery Disposal Area

Based upon water-level measurements taken March 25, 1982 and the results of the metals analyses of ground-water samples collected in December, 1981, an estimate of the total manganese and zinc being discharged into Pond A via perched ground water can be made. The assumptions used to calculate these discharge rates are as follows: 60' 300

- hydraulic conductivity of the saturated soil (waste, fill, fine sand and silt) is 10^{-4} cm/sec (1.7×10^{-1} ft/day)
- hydraulic gradient between perched ground water and Pond A is 0.03

1.7 .17 ft/day
.03
.0051 ft/day

- cross-sectional discharge area through battery waste (via perched ground water) is 20.9 m^2 (225 ft^2)
- manganese concentration in perched ground water is 18 mg/l (conservative average)
- zinc concentration in perched ground water is 4 mg/l (conservative average)
- background concentration of manganese and zinc in perched water is not detectable

Using Darcy's law,

$Q = KiA$, where

Q = discharge (m^3/day)

K = hydraulic conductivity (m/day)

i = hydraulic gradient

A = cross-sectional discharge area (m^2),

the flow to Pond A from the shallow ground water through the battery waste, fill and fine grained sediments is approximately 5.3×10^{-2} m^3/day (14 gallons per day). If the manganese concentration of this water is 18 mg/l, then the discharge rate of manganese is about 0.002 lbs/day. Similarly, if the zinc concentration is 4 mg/l, then the discharge rate of zinc is about 5×10^{-4} lbs/day. Based on the concentration of cadmium, mercury, and lead in perched ground water, the discharge rate of these metals would be less than the estimated amount of zinc discharged. No chromium is being discharged to Pond A as it was not detected in samples of the perched ground water.

4.6.2 Street-Drain Input

The estimated discharge rates for manganese and zinc into Pond A appear even less significant when compared to an estimate of the contribution of storm-water drainage to the pond system. A rough estimate for storm-water drainage can be calculated using the following assumptions:

- annual precipitation (P) for Pine Swamp basin is 48 in/yr (Department of Commerce 1968)
- the total area of the Pine Swamp basin is 775 acres, of which 175 are not developed
- mean runoff coefficient (K) for the basin is .6 (Linsley and Franzini, 1972)
- average zinc concentration of highway runoff is 0.40 mg/l (Clark et al 1981). (No data are available for manganese).

Therefore, mean annual runoff equals K times P or approximately 29 in/yr or 2.8×10^5 gal/day. This results in a discharge of zinc to the total pond system of about 0.9 lb/day if the zinc concentration is 0.4 mg/l. The daily contribution to Pond A could be estimated to be 1/5 of the total input or about 0.2 pounds. This quantity is 400 times the amount of zinc discharged to Pond A via perched ground water. Although no estimate was made for manganese contribution to the ponds from storm runoff, it is assumed that the results would be comparable considering the larger hydrologic input to ponds from runoff versus from perched ground water.

5. DISCUSSION

This section summarizes the results of the field investigation and analytical program, discusses and explains these results, and presents the potential environmental impacts posed by the site conditions.

5.1 Waste Location

The field investigation revealed that there are approximately 3500 cubic yards of waste containing battery remains on site. This waste is confined to a 32,000 square foot area southwest of Pond A. This area is underlain by fine-grained natural sediments, typically comprised of organic silt, silt and clay, or fine sand and silt. These fine-grained sediments block the vertical flow of infiltrating water from the surface to the regional aquifer to an extent sufficient to produce a perched ground-water mound in the battery waste area. Shallow ground-water flow is, therefore, generally lateral toward Pond A.

A full site reconnaissance located three other major disposal areas not addressed in the Phase I investigation. These areas contain incinerator ash, demolition debris, domestic-type refuse and Ramset test pads. They are located to the southwest of Pond A, to the southwest of Pond C and in the southeast kettle.

5.2 Metals

The EP toxicity analyses conducted on samples of waste and naturally occurring sediments revealed that 4 waste samples satisfied EPA's criteria for characterization as a hazardous waste for cadmium and/or lead content. The aggressive leachate medium used in this test, however, is greater than two orders of magnitude more acidic than the ambient pH in the waste and underlying soil. Therefore, the EP toxicity test provides a very conservative characterization of the leaching potential of the metals under existing conditions. These conservative EP toxicity data indicate that the metals of concern are essentially contained within the volume of waste and are not moving into the underlying soil.

Ground-water samples taken from wells screened within the battery waste contain concentrations of metals (primarily zinc and manganese) much higher than in ground-water samples taken from the regional aquifer below the waste. This indicates that some metals are leaching from the battery waste into the shallow ground water but because the shallow ground water flows primarily laterally into Pond A, horizontal flow into the regional aquifer is minimal. Therefore, battery waste does contribute metals to Pond A, but only extremely small quantities to the uppermost portion of the regional aquifer.

The metals analyses show slightly elevated concentrations in Pond A. However, the concentration of metals in the sample from Pond E is no different from background. The metals contribution from the battery waste is either precipitated or diluted in the pond system.

Examination of the bottom sediments in Pond A (where most of the metals precipitation would be taking place) shows metals concentrations below or within the same range as those in Lake Whitney. Hence, the battery waste does not contribute measurably to the metals concentration in the bottom sediments. ERT estimates that other sources, specifically urban runoff, are far more important sources of metals. The amounts of zinc and manganese entering the pond system from the battery waste area are estimated to be about 0.0005 and 0.002 lbs per day respectively. The contribution of zinc from surrounding streets and parking lots is estimated to be on the order of 400 times greater. It is our judgement that the relative contributions of manganese from on- and off-site sources are similar. The data and these estimates suggest that the metals contribution to the pond system from the battery waste area is insignificant compared to other sources.

One other observation is important, the ground water discharging from the site (downgradient) contains metals concentrations less than or within the same order of magnitude as ground water moving onto the site (upgradient). This further supports the observation that leachate from the battery waste area does not impact the regional aquifer.

Based on these observations, ERT concludes that the battery waste does not affect the Lake Whitney resevoir or present drinking-water supplies. Furthermore, we conclude that the battery waste area, if left undisturbed, will not adversely affect the quality of Lake Whitney or future water-supply development downgradient from the site. Based on the low levels of metals leaching from the battery waste and that the waste has been on-site for 25 years (waste disposal operations were discontinued in 1957), we belive that waste is in equilibrium and that no significant changes are likely to occur from that which is presently observed.

5.3 Organics

Low levels of priority and non-priority pollutant organic compounds were detected at concentrations less than 201 ppb in two wells (ERT 2 and 2A) upgradient of Pond A and the battery disposal area. Based on these analytical and ground-water flow data, we belive that off-site sources are probably responsible for the presence of the chemical compounds found in these wells (ERT 2 and 2A). ERT also concluded (in the Phase I investigation) that off-site sources are probably responsible for the presence of organic compounds found in the upgradient Leeds' well and ERT 5.

Low levels (less than 350 ppb) of priority and non-priority pollutant organic compounds were also detected in samples from two out of five wells screened in the perched ground water in the battery disposal area. These compounds probably originated from the battery waste, however, the chemicals found in the shallow ground water are not the same as the chemicals found in the regional aquifer, and the spatial distribution of concentrations provides no consistent pattern. There is no direct link between the presence of organics in the regional aquifer and the shallow ground water in the battery disposal area.

Three priority pollutant organic compounds were detected at low levels (less than 86 ppb) in the regional aquifer underlying the southeast kettle. However, none was detected in the aquifer 200 feet downgradient from the kettle. In addition, the quality of surface and ground water discharging from the site indicates that neither of the other two disposal areas contribute organic chemicals to the surface or ground water.

No priority pollutant organic compounds were detected in the ground water discharging from the site, therefore, the regional aquifer downgradient is not affected by on-site waste disposal. One priority pollutant organic compound was detected in the surface water discharging from the site (11 ppb of 1,1,1-trichloroethane in the Pond E sample), however, the detection limit for this compound is 10 ppb. Therefore, ERT concludes that past waste disposal practices within the Pine Swamp site are not currently affecting the Lake Whitney Resevoir or present drinking-water supplies. In addition, there is no reason to anticipate that these past practices would create a problem in the future.

A separate effort was made to determine the source of odors in water samples from several of the wells. Analyses for non-priority pollutants revealed the presence of elevated concentrations (up to approximately 5300 ppb) of four compounds (tertiary butyl alcohol, acetone, tetrahydrofuran, and ethyl ether). These compounds are the probable sources of odors found in the Davenport well and several on-site wells.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Based on the findings of the Phase II investigation and the results and discussion presented here, ERT concludes the following:

- Waste contained in disposal areas other than the battery waste area does not affect the quality of surface water or ground water discharging from the site.
- Metals in very low concentrations are leaching from the battery disposal area into the shallow ground water and slowly to Pond A.
- Metal consistuents in the battery waste that have leached into the shallow ground water have not redeposited in the underlying natural sediments.
- The quantity of metals emanating from the battery waste is insignificant compared to the quantity of metals contributed to the pond system by off-site sources.
- Metals leaching from the battery waste do not affect Lake Whitney or present downgradient drinking-water supplies.
- If the waste is left undisturbed, metals from the battery waste area will not affect Lake Whitney or future downgradient drinking-water supplies that may be developed.
- Several organic priority pollutants were detected at low concentations in a random distribution around the Pine Swamp study area, however, none of these compounds were present in the samples taken from a ground-water monitoring well screened in the regional aquifier (ERT 7) located at the most downgradient portion of Olin's property. Therefore, ERT concludes that, in relation to organic priority pollutants, past waste disposal activities at the site are not presently having an adverse impact on the quality of drinking water withdrawn from Lake Whitney. Similarly, no future impact is anticipated.

- Odors noted in several of the wells on-site and off-site are probably due to the presence of one or more of four non-priority pollutant organic chemicals in the ground water (tertiary butyl alcohol, acetone, tetrahydrofuran and ethyl ether).

6.2 Recommendations

On the basis of its site investigation and analytical program, ERT believes that, although the site does not now impact downgradient drinking-water supplies, a program should be pursued to further reduce the potential for impact on present or future downgradient drinking-water supplies. This program would consist of fulfilling the following recommendations.

1. During periods of high rainfall, a steady flow of water flows from the broken street drain near ERT 9. The water then washes across the surface of the site and flows into Pond A. This storm-water flow has the potential to wash battery waste constituents directly into Pond A. ERT recommends that the street drain be reconstructed to its original configuration so that it will conduct storm water directly to Pond A, thus shielding it from direct contact with the battery waste.

2. Battery waste is exposed at the surface in several areas, and it is known to contain elevated concentrations of cadmium and lead. ERT recommends that the exposed battery waste be covered with select fill, graded to control runoff and seeded to stabilize the surface.

3. ERT further recommends that a limited ground-water and surface-water monitoring program be designed and implemented to confirm the conclusions discussed in Section 6.1 and to assess long-term impact on future downgradient

drinking-water supplies. This recommendation is based on the following findings: (1) the battery waste is leaching low concentrations of metals into the shallow ground water which discharges to Pond A, (2) low levels of organic compounds have been detected in the shallow and deep ground water which also discharge to the pond system, and (3) the source of the organic and metal constituents appears to be a combination of on-site waste material (battery and other waste) and off-site unspecified contributors. The leaching characteristics of the battery waste have been investigated, and they indicate that the battery waste will probably not increase the concentration of metals it leaches to the shallow ground water. The nature and extent of possible off-site sources have not been investigated. Whether the off-site contribution of organic constituents will change over time cannot be assessed. A ground-water and surface-water monitoring program would provide a reliable body of data upon which changes in constituent contribution to the Pond system and the impact of any change on downgradient drinking-water supplies could be assessed.

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APPENDIX A

BORING LOGS

APPENDIX A

BORING LOGS

EXPLANATION

Type of Sample

SS - Split Spoon, 2 1/2 in inside diameter

A - Auger, soil sample taken off auger flight

Sample numbers are given sequentially, as the samples are taken, while advancing the boring.

Depth Range

The depth range column lists the penetration of the split spoon, and therefore, the approximate depth of the retrieved sample. For an auger sample, the sample depth range indicates the depth at which that part of the auger from which the sample was taken was just prior to backing off the augers out of the boring.

Recovery

The recovery is the length of the sample recovered from the split spoon. It is measured in feet and tenths. Measurement of recovery is not applicable to auger samples.

Graphic Log

The graphic log summarily describes the sedimentary column penetrated by the boring. Horizontal bars are drawn at the approximate depth of a marked change in sediment type as indicated by the name change. These bars are dashed where the change in sediment type is gradational or is schematically located.

Sample Description

Each sample is described as it was observed in the field immediately after extraction. The major macroscopic component of the sample is printed in all capital letters. The lesser components are ranked in order of the approximate percentage of the total sample that they constitute according to the following distribution nomenclature:

Trace	0-10%
Little	10-20%
Some	20-30%
and	30-50%

These percentages were determined visually in the field, and are not intended to be precise, but are representative.

For example: Borings ERT 9 Sample SS1

0.0 - 0.6 Red, coarse to fine SAND, trace gravel up to 2 in, trace silt

This description indicates that from the ground surface (0.0) to a depth of 0.6 ft the soil is composed of at least 80% coarse to fine sand, up to 10% gravel having a maximum diameter of 2 in, and up to 10% silt.

Equipment Installed

For those borings in which observation wells were installed, this column contains a sketch of the well components and their locations within the boring. The material that fills the annulus between the well and the boring wall is noted. A standard water-level symbol indicates the depth to water in the well measured on the day noted.

Abbreviations

- I.D. - inside diameter
- mil - 0.001 in, describes width of well screen slots
- N/A - not applicable
- PVC - polyvinyl chloride, a plastic
- Sch - schedule, a means of ranking the wall thickness of the PVC pipe

Project B300 Olin | Site Hamden CT | **BORING** ERT 9 | Sh 1 of 2

Date Started 12/8/81 | Completed 12/8/81 | Ground Elevation 39.1 ft

Total Depth 10.0 ft | Location | Logged by J.T. Lawson

Casing I.D. N/A | Contractor Clarence Welti Assoc.

Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
						Fill	0.0-0.6 Red, Coarse to fine SAND, trace gravel up to 2 in., trace silt.	Bentonite Seal
	1	SS1		0.0 to 2.0	1.1	Waste	0.6-2.0 Black fine-grained WASTE, battery remains.	
	2						2.0-2.5 Black WASTE trace gravel, oily sheen.	Sand backfill and collapsed deposits
	3	SS2		2.0 to 4.0	1.3	Peat	2.5-4.6 Dark brown PEAT.	
35	4							5 ft 2 in ID 20 mil PVC well screen tip at 5.0 ft
	5	SS3		4.0 to 6.0	1.8	Sand	4.6-5.2 Red coarse to fine SAND, some gravel, trace green speckling. 5.2-5.8 Gray, fine SAND, some silt. 5.8-6.0 Red, medium SAND.	
	6							

12/16/81 ▼

ERT 9

1911 (1/81)

ERT
ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

Project B300 Olin **Site** Hamden CT **BORING** ERT 9 **Sh** 2 **of** 2

Elev. Feet	Depth Feet	Sample Type & Number	Blows per 6 In.	Depth Range	Rec.	Graphic Log	Sample Description	Equipment Installed
	7	SS4		6.0 to 8.0	1.5	Sand	6.0-6.6 Gray, medium to fine SAND, some silt. 6.6-8.0 Red coarse to fine SAND, little gravel.	
30	8 9	SS5		8.0 to	1.5		8.0-10.0 Red, coarse to fine SAND.	
	10						Bottom of boring at 10.0 ft	

1912 (1/81)

ERT
ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

Project B300 Olin **Site** Hamden CT **BORING** ERT 10 **Sh 1 of** 2
Date Started 12/8/81 **Completed** 12/8/81 **Ground Elevation** 38.2 ft
Total Depth 10.0 ft **Location** **Logged by** J.T. Lawson
Casing I.D. N/A **Contractor** Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample Type & Number	Blows per 6 In.	Depth Range	Rec.	Graphic Log	Sample Description	Equipment Installed
	0–2	SS1		0.0 to 2.0	1.1	Fill	0.0-0.2 VEGETAL DEBRIS. 0.2-1.0 Brown SILT. 1.0-2.0 Red medium to fine SAND.	
35	2–4	SS2		2.0 to 4.0	2.0	Or-ganic Silt Silt	2.0-2.8 Black organic SILT, little clay. 2.8-3.0 Gray fine SAND and SILT, little clay. 3.0-4.0 Red coarse to fine SAND and GRAVEL.	Collapsed deposits
	4–6	SS3		4.0 to 6.0	1.8	Sand and Grav-el	4.0-6.0 Red coarse to fine SAND and GRAVEL, trace silt.	

ERT 10

Project B300 Olin **Site** Hamden CT **BORING** ERT 10 **Sh** 2 **of** 2

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
	7	SS4		6.0 to 8.0	1.8	Sand and Gravel	6.0-7.0 Red coarse to fine SAND and GRAVEL, trace silt. 7.0-8.0 Red coarse to fine SAND and GRAVEL, some silt.	
30	8 9	SS5		8.0 to 10.0	1.6		8.0-10.0 Red coarse to fine SAND, little gravel, trace silt.	
	10						Bottom of boring at 10.0 ft	

1912 (1/81)

ERT
ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

Project B300 Olin Site Hampden CT **BORING** ERT 11 Sh 1 of 2

Date Started 12/8/81 Completed 12/9/81 Ground Elevation 39.5 ft

Total Depth 10.0 ft Location Logged by J.T. Lawson

Casing I.D. N/A Contractor Clarence Welti Assoc.

Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
				0.0		Fill	0.0-1.1 Brown and red medium to fine SAND, some silt and building rubble.	
	1	SS1		to	1.6			
				2.0		Waste	1.1-2.0 Black WASTE with battery remains.	
	2			2.0				
	3	SS2		to	0.4		2.0-4.0 Same as above.	Collapsed deposits
				4.0				
	4			4.0			4.0-5.0 Same as above.	
35								
	5	SS3		to	1.7	Silt	5.0-5.1 Gray SILT, some clay.	
							5.1-5.8 Gray, fine SAND, some silt.	
				6.0		Sand	5.8-6.0 Light brown-red, coarse to fine SAND.	
	6							

ERT 11

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
	7	SS4		6.0 to 8.0	1.0	Sand and Gravel	6.0-8.0 Red, coarse to fine SAND and GRAVEL, trace green speckling.	
30	8, 9	SS5		8.0 to 10.0	1.0		8.0-10.0 Red coarse to fine SAND and GRAVEL.	
	10						Bottom of boring at 10.0 ft	

Project B300 Olin **Site** Hamden CT **BORING** ERT 12 **Sh 1 of** 2
Date Started 12/9/81 **Completed** 12/9/81 **Ground Elevation** 42.4. ft
Total Depth 15.0 ft **Location** **Logged by** J.T. Lawson
Casing I.D. N/A **Contractor** Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	1	SS1		0.0 to 2.0	1.5	Fill	0.0-0.4 TOPSOIL, Vegetal remains. 0.4-1.3 Black-stained, coarse to fine SAND, little silt. 1.3-2.0 Red coarse to fine SAND and GRAVEL.	Bentonite Seal
40	2, 3	SS2		2.0 to 4.0	1.5	Sand and Grav-el	2.0-4.0 Same as above.	Collapsed depostis
	4, 5	SS3		4.0 to 6.0	0.6		4.0-6.0 Red coarse to fine SAND, trace fine gravel.	2 in ID PVC riser
	6, 7	SS4		6.0 to 8.0	1.0		6.0-8.0 Red coarse to fine SAND.	▼ 12/17/81

ERT 12

Project B300 Olin	Site Hamden CT	BORING ERT 12 Sh 2 of 2

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
35		SS4		6.0 to 8.0	1.0		6.0-8.0 Red coarse to fine SAND.	
	8–9	SS5		8.0 to 10.0	1.0	Sand	8.0-10.0 Red-yellow, coarse to fine SAND, little silt.	Collapsed deposits; 5 ft 2 in ID 20 mil PVC well screen
30	10–13					Sand		
	13–14	SS6		13.0 to 15.0	0.5		13.0-15.0 Red, medium SAND.	Tip at 13.5 ft
	15						Bottom of boring at 15.0 ft	

Project B300 Olin Site Hamden CT **BORING** ERT 13 Sh 1 of 2
Date Started 12/9/81 Completed 12/9/81 Ground Elevation 38.9 ft
Total Depth 10.0 ft Location Logged by J.T. Lawson
Casing I.D. N/A Contractor Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	1	SS1		0.0 to 2.0	0.5	Fill	0.0-2.0 Red, medium to fine SAND, little wood.	Bentonite Seal
	2						Wood plugs split spoon, auger to 2.5 ft	5 ft 2 in ID 20 mil PVC well screen
	3	SS2		2.5 to 4.0	1.0	Or-ganic Silt	2.5-4.0 Dark brown organic SILT and WOOD.	Sand packing
35	4							
	5	SS3		4.0 to 6.0	1.8	Silt and Sand	4.0-4.8 Gray SILT and fine SAND.	Tip at 5.5 ft
						Sand and Grav el	4.8-5.8 Red-brown, coarse to fine SAND and GRAVEL, trace green speckling.	
							5.8-6.0 Gray SILT and fine SAND, little clay.	
	6			6.0 to 8.0	1.9	Or-ganic Silt	6.0-6.5 Black, organic SILT.	

-12/16/81

ERT 13

Project B300 Olin **Site** Hamden CT **BORING** ERT 13 **Sh** 2 **of** 2

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
		SS4		6.0 to 8.0	1.9	Sand	6.5-8.0 Red, coarse to fine SAND and GRAVEL, trace green speckling.	
30	8 9	SS5		8.0 to 10.0	0.8	and Grav-el	8.0-10.0 Red, medium to fine SAND.	
	10						Bottom of boring at 10.0 ft	

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ERT 13

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Project B300 Olin **Site** Hamden CT **BORING** ERT 14 **Sh 1 of** 2
Date Started 12/10/81 **Completed** 12/10/81 **Ground Elevation** 39.2 ft
Total Depth 10.0 ft **Location** **Logged by** J.T. Lawson
Casing I.D. N/A **Contractor** Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	0–2	SS1		0.0 to 2.0	0.6	Fill	0.0-2.0 Red medium to fine SAND, trace grass, roots.	Bentonite Seal; Sand packing; 4 ft 2 in ID 20 mil PVC well screen tip at 4.2 ft
	2–4	SS2		2.0 to 4.0	0.6	Fill	2.0-4.0 Red medium to fine SAND and WOOD, little black silt, waste?	12/16/81
35	4–6	SS3		4.0 to 6.0	1.4	Sand and Silt	4.2-4.8 Gray fine SAND and SILT.	
						Sand and Gravel	4.8-6.0 Red-brown, coarse to fine SAND and GRAVEL, trace green speckling.	
	6–							

ERT 14

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Project B300 Olin **Site** Hamden CT **BORING** ERT 14 **Sh** 2 **of** 2

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
				6.0			6.0-8.0 Red and yellow coarse to fine SAND and GRAVEL, trace silt.	
	7	SS4		to	1.4			
						Sand		
				8.0				
	8					and		
				8.0			8.0-10.0 Red coarse to fine SAND and GRAVEL.	
	9	SS5		to	1.0	Gravel		
30								
				10.0				
	10						Bottom of boring at 10.0 ft	

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Project B300 Olin **Site** Hamden CT **BORING** ERT 15 **Sh 1 of** 2
Date Started 12/10/81 **Completed** 12/10/81 **Ground Elevation** 39.9 ft
Total Depth 10.0 ft **Location** **Logged by** J.T. Lawson
Casing I.D. N/A **Contractor** Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	1	SS1		0.0 to 2.0	1.6	Fill	0.0-0.5 Gray, medium to fine SAND, some silt.	Bentonite Seal
						Waste	0.5-2.0 Black WASTE, battery remains, and brown medium to fine SAND, little silt.	2 in ID PVC Riser
	2, 3	SS2		2.0 to 4.0	2.0	Organic Silt	2.0-2.6 Black, organic SILT.	
						Sand	2.6-3.7 Brown-red, medium to fine SAND, little silt, trace fine gravel.	▼ 12/16/81
							3.7-4.0 Red, coarse to fine SAND and GRAVEL.	
35	4, 5	SS3		4.0 to 6.0	1.8	Sand and Gravel	4.0-6.0 Red, coarse to fine SAND and GRAVEL, trace silt.	5 ft 2 in ID 20 mil PVC well screen
	6							Pea stone packing

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Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
	7	SS4		6.0 to 8.0	1.8	Sand	6.0-8.0 Red, coarse to fine SAND, trace silt, trace green speckling at 7.7-8.0.	Tip at 8.1 ft
	8							
	9	SS5		8.0 to 10.0	1.9	and Gravel	8.0-10.0 Red, coarse to fine SAND and GRAVEL, trace silt.	
30	10						Bottom of boring at 10.0 ft	

Project B300 Olin Site Hamden CT **BORING** ERT 16 Sh 1 of 2
Date Started 12/11/81 Completed 12/11/81 Ground Elevation 40.7 ft
Total Depth 10.0 ft Location Logged by J.T. Lawson
Casing I.D. N/A Contractor Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
				0.0		Fill	0.0-0.6 Red coarse to fine SAND, little gravel, trace vegetal debris.	Bentonite Seal
40	1	SS1		to	1.7	Waste	0.6-2.0 Black and white WASTE, brick bats, ash, cinders.	
				2.0				2 in ID PVC riser
	2			2.0			2.0-4.0 Red, coarse to fine SAND, trace silt and gravel.	
	3	SS2		to	1.8			Collapsed deposit
				4.0		Sand		
	4			4.0			4.0-6.0 Red, coarse to medium SAND, trace silt.	▼ 12/16/81
35	5	SS3		to	1.8			
				6.0				
	6							

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Project B300 Olin	Site Hamden CT	BORING ERT 16	Sh 2 of 2

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
	7	SS4		6.0 to 8.0	2.0	Sand	6.0-7.0 Red, coarse to medium SAND. 7.0-8.0 Red, medium to fine SAND, trace silt.	5 ft 2 in ID 20 mil PVC well screen tip at 10.0 ft
30	8 9	SS5		8.0 to 10.0	1.8		8.0-10.0 Same as above.	
	10						Bottom of boring at 10.0 ft	

ERT 16

Project B300 Olin **Site** Hamden CT **BORING** ERT 17 **Sh 1 of** 2

Date Started 12/11/81 **Completed** 12/11/81 **Ground Elevation** 40.3 ft

Total Depth 12.0 ft **Location** **Logged by** J.T. Lawson

Casing I.D. N/A **Contractor** Clarence Welti Assoc.

Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 in.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
40	1	SS1		0.0 to 2.0	0.9	Fill	0.0-2.0 Brown-red, coarse to fine SAND, little silt, trace gravel, roots and waste.	Bentonite Seal 12/16/81
	2 3			2.0 to 4.0	0	Waste and Fill	No recovery. Augers bind in chicken wire	
35	4 5	SS2		4.0 to 6.0	0.2		Wood from buried tree limb plugs shoe on split spoon.	5 ft 2 in ID 20 mil PVC well screen Sand packing
	6							

ERT 17

Project	B300 Olin	Site	Hamden CT	BORING ERT 17	Sh 2	of 2

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	7	SS3		6.0 to 8.0	1.2	Silt	6.0-6.5 Black, organic SILT, trace sand and gravel. 6.5-7.0 Brown, coarse to fine SAND, some silt, little peat, trace wood. 7.0-8.0 Black, organic SILT, odor.	well screen tip at 7.5 ft
	8, 9	SS4		8.0 to 10.0	1.5	Peat / Sand	8.0-8.8 Black Peat, trace sand and wood, odor. 8.8-10.0 Red coarse to fine SAND, little gravel.	
30	10, 11	SS5		10.0 to 12.0	1.8	Sand	10.0-12.0 Red coarse to fine SAND, little fine gravel.	
	12						Bottom of boring at 12.0 ft	

Project B300 Olin	**Site** Hamden CT	**BORING** ERT 18	**Sh 1 of** 2			
Date Started 12/14/81	**Completed** 12/14/81	**Ground Elevation** 39.1 ft				
Total Depth 15.0 ft	**Location**	**Logged by** J.T. Lawson				
Casing I.D. N/A	**Contractor** Clarence Welti Assoc.					
Remarks						

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	0–1	SS1		0.0 to 1.0	1.0	Fill	0.0-0.8 Red medium to fine SAND, little vegetal matter. 0.8-1.0 Black SILT and red, medium to fine SAND, little cloth, concrete and gravel.	
	1–2.5				0		1.0-2.5 Concrete, could not Sample.	
	2.5–4	SS2		2.5 to 4.0	1.3	Waste	2.5-4.0 Black, WASTE, battery remains, glass, incinerator residue.	▼ 12/16/81
35	4–6	SS3		4.0 to 6.0	1.3	Organic Silt Silt and Clay fine Sand	4.0-4.5 Black, organic SILT. 4.5-5.0 Gray SILT and CLAY, trace fine sand.	Bentonite Seal
	6–8	SS4		6.0 to 8.0	0.9		6.0-6.6 Gray, fine SAND, little silt, trace organic matter.	

ERT 18

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
		SS4		6.0 to 8.0	0.9		6.6-8.0 Red, coarse to fine SAND, little gravel.	Bentonite Seal
	8							
		SS5		8.0 to 10.0	1.3	Sand	8.0-10.0 Red, coarse to fine SAND, some gravel.	
	9							
30								
	10							5 ft 2 in ID 20 mil well screen
	11							
	12					Sand		Collapsed deposit
	13	SS6		13.0 to 15.0	0.3		13.0-15.0 Red, medium to fine SAND.	
	14							Tip at 15.0 ft
25								
	15						Bottom of boring at 15.0 ft	

Project B300 Olin **Site** Hamden CT **BORING** ERT 19 **Sh 1 of** 1

Date Started 12/14/81 **Completed** 12/14/81 **Ground Elevation** 39.1 ft

Total Depth 4.5 ft **Location** **Logged by** J.T. Lawson

Casing I.D. N/A **Contractor** Clarence Welti Assoc.

Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
								Bentonite Seal
38	1						No samples taken.	12/16/81 4.5 ft 2 in ID 20 mil well screen tip at 4.5 ft
	2							
	3							
35	4							
							Bottom of boring at 4.5 ft	

ERT 19

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Project B300 Olin	**Site** Hamden CT	**BORING** ERT 20	**Sh 1 of** 2
Date Started 12/14/81	**Completed** 12/14/81		**Ground Elevation** 39.4 ft
Total Depth 15.0 ft	**Location**	**Logged by** J.T. Lawson	
Casing I.D. N/A	**Contractor** Clarence Welti Assoc.		
Remarks			

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 in.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	1	SS1		0.0 to 2.0	1.6	Fill	0.0-0.1 TOPSOIL, Vegetal debris 0.1-1.3 Red, medium to fine SAND, trace silt and coarse sand.	Bentonite Seal
						Waste	1.3-2.0 Black WASTE, battery remains.	
	2, 3	SS2		2.0 to 4.0	0.2	Waste	2.0-4.0 Red and black medium to fine SAND and black WASTE, battery remains, trace coarse sand.	▼ 12/16/81
35	4	SS3		4.0 to 6.0	1.1	Silt & Clay	4.0-4.3 Gray SILT and CLAY, trace fine sand.	2 in ID riser
	5					fine Sand	4.3-6.0 Gray, fine sand, little silt, odor.	
	6	SS4		6.0 to 8.0	1.1	Sand and Gravel	6.0-8.0 Red, coarse to fine SAND and fine GRAVEL, 6.0-6.2 Stained green.	

ERT 20

Project B300 Olin **Site** Hamden CT **BORING** ERT 20 **Sh** 2 **of** 2

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
		SS4		6.0 to 8.0	1.1		See page 1.	Bentonite Seal
	8	SS5		8.0 to 10.0	1.3	Sand	8.0-10.0 Red, coarse to fine SAND and fine GRAVEL, odor.	
30	9							
	10					and		5 ft 2 in ID 20 mil well screen tip at 15.0 ft
	11					Grav el		
	12							
	13	SS6		13.0 to 15.0	0		No recovery. Red sand in wash.	Collapsed deposit
25	14							
	15						Bottom of boring at 15.0 ft	

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Project	B300 Olin	Site	Hamden CT	BORING	ERT 21	Sh 1 of	1
Date Started	12/15/81	Completed	12/15/81	Ground Elevation	39.4 ft		
Total Depth	4.0 ft	Location		Logged by	J.T. Lawson		
Casing I.D.	N/A	Contractor	Clarence Welti Assoc.				
Remarks							

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
								▼ 12/16/81 Bentonite Seal
	1							
38							No samples taken.	4 ft 2 in ID 20 mil PVC well screen tip at 4.0 ft
	2							
	3							Sand packing
	4						Bottom of boring at 4.0 ft	
35								

ERT 21

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Project B300 Olin **Site** Hamden CT **BORING** ERT 22 **Sh 1 of** 2

Date Started 12/15/81 **Completed** 12/15/81 **Ground Elevation** 37.3.ft

Total Depth 9.0 ft **Location** **Logged by** J.T. Lawson

Casing I.D. N/A **Contractor** Clarence Welti Assoc.

Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
				0.0			0.0-2.0 Brown VEGETAL MATTER, little silt.	Bentonite Seal 12/16/81
	1	SS1		to	0.1	Or-ganic Silt		
				2.0				5 ft 2 in ID 20 mil PVC well screen tip at 5.0 ft
	2			2.0			2.0-2.3 Black, organic SILT.	
35						Silt Clay	2.3-2.6 Gray-green SILT and CLAY, trace fine sand.	
	3	SS2		to	1.6		2.6-3.1 Green and red, coarse to fine SAND and GRAVEL, some silt, little clay.	Sand packing
				4.0		Sand		
	4			4.0		and	3.1-4.0 Red, coarse to fine SAND and GRAVEL.	
	5	SS3		to	1.5	Grav-el	4.0-6.0 Same as above.	
				6.0				
	6							

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Project B300 Olin						Site Hamden CT		BORING ERT 22 Sh 2 of 2
Elev. Feet	Depth Feet	Sample: Type & Number	Blows per 6 In.	Depth Range	Rec.	Graphic Log	Sample Description	Equipment Installed
30	7	SS4		6.0 to 8.0	0.3	Sand and Grav-el	6.0-8.0 Red, coarse to fine SAND and GRAVEL.	
	8	SS5		8.0 to 9.0	0		8.0-9.0 No recovery. Refusal at 9.0 ft.	
	9						Bottom of boring at 9.0 ft	

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Project B300 Olin **Site** Hamden CT **BORING** ERT 23 **Sh 1 of** 2
Date Started 12/15/81 **Completed** 12/16/81 **Ground Elevation** 39.6 ft
Total Depth 12.0 ft **Location** **Logged by** J.T. Lawson
Casing I.D. N/A **Contractor** Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	0–2	SS1		0.0 to 2.0	1.8	Fill	0.0-0.7 Red, medium to fine SAND, trace silt.	Bentonite Seal
						Waste	0.7-2.0 Black WASTE, battery remains.	12/16/81
	2–4			2.0 to 4.0	0	Waste	2.0-4.0 No recovery.	5.0 ft 2 in ID 20 mil well screen tip at 5.0 ft
35	4–6	SS2		4.0 to 6.0	1.0	Waste	4.0-4.3 Black PEAT and WASTE, battery remains.	Sand packing
							4.3-4.6 Gray SILT, and CLAY, trace fine sand, organic matter, fine gravel.	
							4.6-6.0 Gray SILT, some fine sand, little clay.	

ERT 23

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
	7			6.0 to 8.0	0	Waste	6.0-8.0 No recovery.	
30	8, 9	SS3		8.0 to 10.0	1.8	Waste	8.0-8.2 Black SILT and TEXTILE material, oily sheen, odor. 8.2-8.8 Gray SILT little clay, trace fine sand. 8.8-9.3 Red and white TEXTILE material, some medium to fine sand. 9.3-10.0 Red, coarse to fine SAND and GRAVEL, odor.	
	10, 11	SS4		10.0 to 12.0	1.8	Sand and Grav el	10.0-12.0 Same as above.	
	12						Bottom of boring at 12.0 ft	

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1812 (1/81)

Project B300 Olin **Site** Hamden CT **BORING** ERT 24 **Sh 1 of** 1
Date Started 12/16/81 **Completed** 12/16/81 **Ground Elevation** 39.8 ft
Total Depth 4.0 ft **Location** **Logged by** J.T. Lawson
Casing I.D. N/A **Contractor** Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
39	1						No samples taken.	Bentonite Seal 12/17/81 4 ft 2 in ID 20 mil well screen tip at 4.0 ft
	2							
36	3							
	4						Bottom of boring at 4.0 ft	

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Project	B300 Olin	Site	Hamden CT	**BORING**	ERT 25	Sh 1 of	1
Date Started	12/16/81	Completed	12/16/81	Ground Elevation	39.2.ft		
Total Depth	4.5 ft	Location		Logged by	J.T. Lawson		
Casing I.D.	N/A	Contractor	Clarence Welti Assoc.				
Remarks							

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
39						Fill	0.0-1.6 Red, medium to fine SAND, trace wood fragments.	
	1							
	2	A1		1.6 to 2.6	N/A	Organic Silt	1.6-2.6 Black, organic SILT.	
	3							
35	4	A2		3.5 to 4.5	N/A	Silt and fine Sand	3.5-4.5 Gray SILT and fine SAND, little clay. Bottom of boring at 4.5 ft	

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Project B300 Olin **Site** Hamden CT **BORING** ERT 26 **Sh 1 of** 1

Date Started 12/16/81 **Completed** 12/16/81 **Ground Elevation** 39.4 ft

Total Depth 5.0 ft **Location** **Logged by** J.T. Lawson

Casing I.D. N/A **Contractor** Clarence Welti Assoc.

Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
39	0–1.5					Fill	0.0-1.5 Red, medium to fine SAND, trace wood fragments.	
	1.5–3.0	A1		1.5 to 3.0	N/A	Or-anic Silt	1.5-3.0 Black, organic SILT.	
35	3.2–5.0	A2		3.2 to 5.0	N/A	Sand	3.2-5.0 Gray, fine SAND, some silt, little fine gravel, trace clay, green speckling.	
	5						Bottom of boring at 5.0 ft	

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Project B300 Olin	**Site** Hamden CT	**BORING** ERT 27	**Sh 1 of** 1	
Date Started 12/16/81	**Completed** 12/16/81		**Ground Elevation** 42.8 ft	
Total Depth 4.5 ft	**Location**		**Logged by** J.T. Lawson	
Casing I.D. N/A		**Contractor** Clarence Welti Assoc.		
Remarks				

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
		A1		0.0 to 0.5		Waste	0.0-0.5 Black WASTE.	
42	1							
40	2 3 4	A2		1.8 to 4.5		Fill	1.8-4.5 Red, coarse to fine SAND and fine GRAVEL, trace Silt. Bottom of boring at 4.5 ft	

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Project B300 Olin Site Hamden CT **BORING** ERT 28 Sh 1 of 1
Date Started 12/16/81 Completed 12/16/81 Ground Elevation 43.3 ft
Total Depth 5.0 ft Location Logged by J.T. Lawson
Casing I.D. N/A Contractor Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
		A1		0.0 to 0.5	N/A	Waste	0.0-0.5 Gray-green WASTE, cartridge casings.	
							0.5-1.0 Black WASTE.	
42	1	A2		1.0 to 5.0	N/A	Fill	1.0-5.0 Red, coarse to fine SAND and fine GRAVEL.	
40	2, 3, 4							
	5						Bottom of boring at 5.0 ft	

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Project B300 Olin Site Hamden CT **BORING** ERT 29 Sh 1 of 4

Date Started 12/17/81 Completed 12/17/81 Ground Elevation 43.1 ft

Total Depth 25.5 ft Location Logged by J.T. Lawson

Casing I.D. N/A Contractor Clarence Welti Assoc.

Remarks

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
				0.0			0.0-0.2 Brown TOPSOIL, some vegetal debris.	Bentonite Seal
							0.2-2.0 Red-brown coarse to fine SAND and GRAVEL.	
	1	SS1		to	2.0			
				2.0		Sand		
	2							2 in ID PVC riser
40	3					and		
						Gravel		
	4							
	5			5.0			5.0-7.0 Red, coarse to fine SAND and GRAVEL.	
	6	SS2		to	1.5			▼ 12/22/81
				7.0				

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Project B300 Olin | Site Hamden CT | BORING ERT 29 Sh 2 of 4

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
35	8							Collapsed deposit
	9					Sand		
	10			10.0		and	10.0-12.0 Red, coarse to fine SAND and GRAVEL	
						Grav el		
	11	SS3		to	2.0			
				12.0				15.0 ft 2 in ID 20 mil PVC well screen
	12							
30	13							
	14							
	15							

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Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	16	SS4		15.0 to 17.0	1.3		15.0-17.0 Red, coarse to fine SAND and GRAVEL.	
25	17–18					Sand and Gravel		15.0 ft 2 in ID 20 mil PVC well screen
	19							
	20–21	SS5		20.0 to 22.0	2.0		20.0-22.0 Same as above.	Collapsed deposit
20	22–23							

Project	B300 Olin	Site	Hamden CT	BORING ERT 29	Sh 4 of 4

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
	24					Sand and Gravel		15.0 ft 2 in ID 20 mil PVC well screen tip at 25.5 ft
18	25							
							Bottom of boring at 25.5 ft	

ERT 29

Project B300 Olin **Site** Hamden CT **BORING** ERT 30 **Sh 1 of** 2
Date Started 12/17/81 **Completed** 12/17/81 **Ground Elevation** 42.2 ft
Total Depth 14.0 ft **Location** **Logged by** J.T. Lawson
Casing I.D. N/A **Contractor** Clarence Welti Assoc.
Remarks

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
				0.0			0.0-2.0 Red coarse to fine SAND, little gravel, trace silt, roots, coal.	Bentonite Seal
	1	SS1		to	1.3	Sand		
				2.0				
	2							
40								
								2 in ID PVC riser
	3							
	4							
	5							
								12/17/81
	6							

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Project	B300 Olin	Site	Hamden CT	BORING ERT 30	Sh 2 of 2

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
35	7			7.0 to 9.0	0		7.0-8.0 No recovery.	Collapsed deposit
	8							
	9			9.0 to 11.0	0		9.0-11.0 No recovery.	5 ft 2 in ID 10 mil PVC well screen tip at 12.5 ft
	10							
	11							
30	12			12.0 to 14.0	2.0	Sand	12.0-14.0 Red, coarse to fine SAND, some fine gravel.	
	13							
	14						Bottom of boring at 14.0 ft	

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Project B300 Olin	Site Hamden CT	**BORING** ERT 31	Sh 1 of 2	
Date Started 12/18/81	Completed 12/18/81	Ground Elevation 38.3 ft		
Total Depth 12.0 ft	Location	Logged by J.T. Lawson		
Casing I.D. N/A	Contractor Clarence Welti Assoc.			
Remarks				

Elev. Feet	Depth Feet	Sample: Type & Number	Sample: Blows per 6 In.	Sample: Depth Range	Sample: Rec.	Graphic Log	Sample Description	Equipment Installed
				0.0		Silt	0.0 to 0.5 Dark brown SILT some vegetal debris.	Bentonite Seal 12/18/81
	1	SS1		to	1.2		0.5-2.0 Red, coarse to fine SAND and GRAVEL wood plugs shoe of split spoon.	
				2.0		Sand		
	2					and		2 in ID PVC riser
						Grav el		
	3							
35								
	4							
	5			5.0			5.0-7.0 Light brown, medium SAND, trace silt, fine sand, organic matter.	
	6	SS2		to	1.8	Sand		
				7.0				

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Project	B300 Olin	Site	Hamden CT	BORING ERT 31	Sh 2	of 2

Elev. Feet	Depth Feet	Sample Type & Number	Sample Blows per 6 In.	Sample Depth Range	Sample Rec.	Graphic Log	Sample Description	Equipment Installed
								Collapsed deposit
	7							5 ft 2 in ID 20 mil PVC well screen tip at 9.5 ft
	8							
30						Sand		
	9							
	10			10.0			10.0-12.0 Red, medium to fine SAND.	
	11	SS3		to	0.5			
				12.0				
	12						Bottom of boring at 12.0 ft	
25								

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566 7159

Talk to Emma re Tina Seang - Healthy City Office

566 - 365 Principal Sanitary Engineer

5668903 Dr. Millow ~~Senior Environment~~

Dr. Barlow - assistance Director Water Compliance

Robert Louie Director Water Compliance

Deputy